PLANT DISEASES IN COLOR

BY

ANNIE L. LOHR

DIVISION OF PLANT QUARANTINES

Superior Service Awards 1956

ANNIE L. LOHR, ARS; WASHINGTON, D. C.

For planning and preparing a book, "Plant Diseases in Color," illustrating the symptomology of plant diseases, for use as an in-service training tool for plant quarantine inspectors.

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KODACHROMES
BY
WILLIS H. WHEELER
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UNITED STATES DEPARTMENT OF AGRICULTURE
U.S. AGRICULTURAL RESEARCH SERVICE
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PREFACE

THE IDEA FOR THIS MANUAL WAS CONCEIVED MANY YEARS AGO. DIFFERENT COLOR PROCESSES WERE TRIED AS THEY WERE INTRODUCED. HOWEVER, NONE SEEMED TO PRODUCE THE DESIRED RESULTS UNTIL EASTMAN KODAK COMPANY STARTED ITS SERVICE OF PRODUCING KODACOLOR NEGATIVES FROM KODACHROMES, THEN MAKING PRINTS FROM THE KODACOLOR NEGATIVES.

PRIOR TO THIS, MR. WHEELER AND I HAD STARTED TO DOCUMENT CERTAIN PLANT DISEASES BY PHOTOGRAPHING THEM IN COLOR. AFTER TRYING THE NEW EASTMAN SERVICE WE WERE CONVINCED THAT THE COLORS OF THE DISEASE SYMPTOMS COULD IN MOST CASES BE REPRODUCED ACCURATELY ENOUGH FOR SYMPTOMATIC DETERMINATIONS.

EXACT DATA ON MAGNIFICATION FOR EACH PHOTOGRAPH ARE NOT AVAILABLE. IN SOME CASES THE OBJECT APPEARS AS APPROXIMATELY NATURAL SIZE IN THE PRINT (SEE NO. 22). OTHERS HAVE BEEN ENLARGED TO AS MUCH AS SEVEN TIMES (SEE NO. 40), BUT IN EACH CASE AN EFFORT WAS MADE TO PRODUCE A PICTURE THAT WOULD FURNISH THE AMOUNT OF DETAIL NECESSARY TO GIVE A CLEAR UNDERSTANDING OF THE DISEASE SYMPTOMS PORTRAYED.

THIS COMPILATION IS PRIMARILY FOR THE USE OF PLANT QUARANTINE INSPECTORS OF THIS BRANCH, TO ASSIST THEM IN RECOGNIZING THE TYPES OF INJURY CAUSED BY PLANT DISEASE ORGANISMS.

I WISH TO EXPRESS GRATITUDE TO MRS. ALICE J. WATSON AND MISS EDITH K. CASH FOR THEIR HELP IN TRANSLATING, FROM LATIN INTO ENGLISH, CERTAIN OF THE FUNGUS DESCRIPTIONS USED IN THIS BOOK. MY THANKS GO LIKEWISE TO ALL PLANT QUARANTINE INSPECTORS FOR THE CARE EXERCISED IN PREPARING AND SHIPPING THE PLANT DISEASE SPECIMENS; TO MISS BESSIE CARPENTER FOR HER EXCELLENT WORK OF TYPING AND PROOF-READING THE MANUSCRIPT; AND TO MR. WILLIS H. WHEELER FOR HIS SUPPORT, ENCOURAGEMENT, SUGGESTIONS, CORRECTIONS AND UNLIMITED PATIENCE IN CONNECTION WITH THE PRODUCTION OF THIS BOOK.

THIS LEATHER BINDER WAS USED SINCE THE FILLERS PROVIDED THE PROPER PROTECTION FOR THE COLOR PRINTS. IN USING THIS BOOK IT WOULD BE ADVISABLE TO PROTECT THE PRINTS FROM LONG EXPOSURES TO ANY BRIGHT LIGHT.

CORRECTIONS AND SUGGESTIONS WOULD BE VERY MUCH APPRECIATED.

A. L. L.

FOREWORD

THE PLANT QUARANTINE BRANCH, IN ATTEMPTING TO MODERNIZE ITS TRAINING PROGRAM, HAS RECOGNIZED THE VALUE OF VISUAL EDUCATION. AS A PART OF SUCH EDUCATION IT WAS LONG AN AMBITION OF MINE THAT WE SHOULD OFFER TO OUR ASSOCIATES IN PLANT QUARANTINE WORK A TEXT TO ILLUSTRATE IN COLOR AT LEAST SOME OF THE SYMPTOMS OF PLANT DISEASES. IT HAS FINALLY REMAINED FOR OUR BRANCH ASSOCIATE, MRS. ANNIE L. LOHR, TO BRING TO US SUCH A TEXT BEAUTIFULLY ILLUSTRATED WITH COLOR PHOTOGRAPHS PREPARED FROM KODACHROMES.

THE COLOR PHOTOGRAPHS THEMSELVES WERE IN MOST CASES PREPARED BY MRS. LOHR, WHO BY PERSISTENCE AND A CAREFUL ATTENTION TO DETAIL HAS BECOME ADEPT AT THE PARTICULAR PHASE OF PHOTOGRAPHY REQUIRED. SPECIMENS USED WERE CHOSEN FOR THEIR ILLUSTRATIVE VALUE WITHOUT PARTICULAR REGARD TO THEIR ORIGIN. THEREFORE, SOME WERE FROM FOREIGN SOURCES AND OTHERS CAME FROM COLLECTIONS MADE WITHIN THE BORDERS OF THIS COUNTRY.

IT IS THE INTENTION THAT THIS BOOK SHALL BE ONE OF THE ESSENTIAL TOOLS TO BE USED IN FUTURE IN-SERVICE TRAINING COURSES OFFERED TO PLANT QUARANTINE INSPECTORS WHO ARE CONTINUALLY CALLED UPON IN THEIR DAILY ACTIVITIES TO RECOGNIZE THE POSSIBLE PRESENCE OF PLANT DISEASES IN IMPORTED PLANT MATERIALS THAT COULD REPRESENT A THREAT TO AMERICAN AGRICULTURE. TO THAT END I HEARTILY COMMEND THIS BOOK FOR CAREFUL STUDY BY OUR ASSOCIATES.

WILLIS H. WHEELER, HEAD
NURSERY STOCK SECTION
JANUARY 1956

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GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE SCHW., ON MALUS SYLVESTRIS (TWIG)

THE PHOTOGRAPH SHOWS MANY AECIA FROM WHICH MOST OF THE AECIOSPORES HAVE ESCAPED. THE FRINGE WHICH APPEARS AROUND THE TOP OF THE AECIUM IS FORMED BY STRINGS OF PERIDIAL CELLS SPLITTING DOWNWARD, INDICATING A DRY ATMOSPHERIC CONDITION. WHEN THE PERIDIA BECOME WET THEY CURVE INWARD, CLOSING THE AECIUM. THE AECIOSPORES ARE GLOBOID OR BROADLY ELLIPSOID, FINELY VERRUCOSE, 16-24 X 21-31 MU, WITH LIGHT CHESTNUT BROWN WALLS, 2-3 MU THICK, THE PORES 8-10, DISTINCT.

PYCNIA ARE FORMED ON THE UPPER SIDE OF THE LEAF. UREDIA WANTING. TELIA ARE CYLINDRIC OR CYLINDRIC-ACUMINATE 1.5 TO 3 MM. IN DIAMETER AND 10 TO 20 MM. LONG, ARISING FROM THE CEDAR GALL. TELIOSPORES ARE TWO-CELLED RHOMBIC-OVAL OR NARROWLY ELLIPSOID, 15-21 X 42-65 MU, PALE CINNAMON BROWN, PEDICELLATE.

PLANT PATHOLOGY BY JOHN C. WALKER. P. 422. 1950.

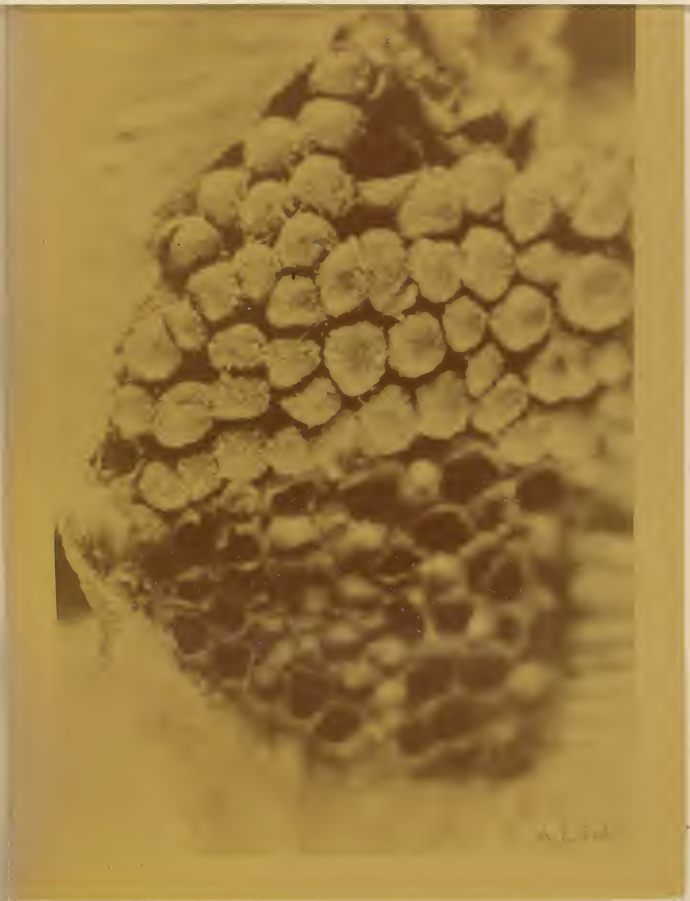
GYMNOSPORANGIUM HARAEANUM SYD., ON JUNIPERUS CHINENSIS (DWARF TREE)

PYCNIA EPIPHYLLOUS. AECIA HYPOPHYLLOUS, CYLINDRIC, 2-3 MM. HIGH, SOON LACERATE AND CANCELLATE, ERECT OR SOMEWHAT SPREADING, THE PERIDIAL CELLS BROADLY LANCEOLATE, OR ROUNDED AT ENDS, THE OUTER WALL 1.5-2 MU THICK, THE INNER 5-7 MU, THE SIDE WALLS COARSELY RUGOSE WITH RIDGES EXTENDING ENTIRELY ACROSS; AECIOSPORES GLOBOID, 18-23 MU IN DIAMETER; WALL PALE CINNAMON-BROWN, 1.5-2 MU THICK, VERRUCOSE, THE PORES 6-10. ON PYRUS SINENSIS AND P. JAPONICA.

UREDIA WANTING. TELIA (SHOWN IN THE PRINT), FOLIICOLOUS, PULVINATE, FORMING GELATINOUS MASSES, BECOMING DARK-BROWN; TELIOSPORES ELLIPSOID, 16-23 X 35-50 MU, ROUNDED OR NARROWED AT BOTH ENDS; WALL CINNAMON-BROWN, UNIFORMLY 1.5-2 MU THICK, THE PORES 2 IN EACH CELL NEAR SEPTUM, OR ONE OF THE PORES IN UPPER CELL NEAR APEX; PEDICEL MODERATELY LONG. ON JUNIPERUS CHINENSIS.

MANUAL OF THE RUSTS IN UNITED STATES AND CANADA, BY DR. J. C. ARTHUR. P. 366. 1934.

GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE SCHW. 1
ON MALUS SYLVESTRIS



THECOPSORA AREOLATA (FR.) MAGN. I, ON PICEA EXCELSA CONE

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GYMNOSPORANGIUM JAPONICUM SYD., ON JUNIPERUS CHINENSIS STEM

4

Thecopsora areolata (Fr.) Magn., on Picea excelsa

The photograph illustrates the aecial stage of the rust. The aecidia give rise to collections of brown warts on the inner sides of the scales of the spruce cones. The windblown aeciospores are irregular, round to elliptic, or rarely oblong, and measure 16-22 X 18-35 mu; dirty yellow-red, later turning to pale yellow. Infection occurs on the young leaves of Prunus padus, P. serotinia, and P. virginiana usually in May.

Uredia and telia follow in order on the prunus leaves. After maturity the teliospores germinate to produce basidiospores. They in turn are windborne to the spruce cones and the cycle is completed. Urediospores measure 10-16 X 15-23 mu, are spiney, yellow, sphaeroid to elliptical, roughly angular, and acute. Telia epiphyllous, within the epidermal cells, irregularly crusted, slightly convex and sometimes angular, at first brownish-red, small, at length becoming dark brown and confluent; teliospores developing in and filling the epidermal cells, round to cube-shaped, longitudinally septate, 2-4 celled, up to 30 mu long, brown, cells prismatic to cylindrical in shape.

Fungous Diseases of Plants, by Jakob Eriksson. p. 237. 1930.
Saccardo V.7:764 & 824.

Gymnosporangium japonicum Syd., on Juniperus chinensis (stem)

Telia (illustrated) caulicolorus, from a perennial mycelium, on fusiform enlargements, irregularly wedge-shaped, often incised at apex, with hollows below, 3-5 mm. high, cinnamon-brown; teliospores ellipsoid, 18-22 X 57-66 mu, usually narrowed above and below; wall pale cinnamon-brown, uniformly 1-1.5 mu thick, the pores two in each cell near the septum; pedicel very long.

The pycnia and aecia are found on Photinia arbutifolia and Pyrus "sinensis". Pycnia epiphyllous. Aecia hypophyllous, cylindric, rupturing apically, mostly remaining tubular, the peridial cells lanceolate in face view, with the outer wall 2-3 mu thick, smooth, the inner 5-7 mu, densely and sharply subspinulose; aeciospores globoid or ellipsoid, 17-18 X 19-23 mu, wall dingy yellow, 2.5-3.5 mu thick, verrucose, the pores 6 to 10.

Manual of the Rusts in United States and Canada, by Dr. J. C. Arthur. p. 372.

Uredo oncidii P. Henn., on Zygopetalum burti

Sori amphigenous, spots dark, round, of various sizes, at length becoming irregular and confluent, somewhat thickened, more or less numerous and pustulate, covered by the pale epidermis, at length opening by a central minute pore, orange, 1/2 - 1 mm. in diameter, spores ovate to ellipsoid, sparingly spiny (especially at the apex), yellow to yellow-brown, 22-30 X 15-22 mu, epispore 1.5 - 2.5 mu thick, germ pore obscure.

Hedwigia 41:15. 1902.
Sydow, Monographia Uredinearum 4:505. 1924.

Uromyces abbreviatus Arth., III, on Psoralea physodes

Pycnia hypophyllous.
Aecia and uredia wanting.
Teliospores broadly obovoid, 21-26 X 26-42 mu, chestnut-brown; wall uniformly 3 mu thick; pore at apex and slightly projecting; pedicle hyaline, delicate, as long as the spore, usually disappearing.

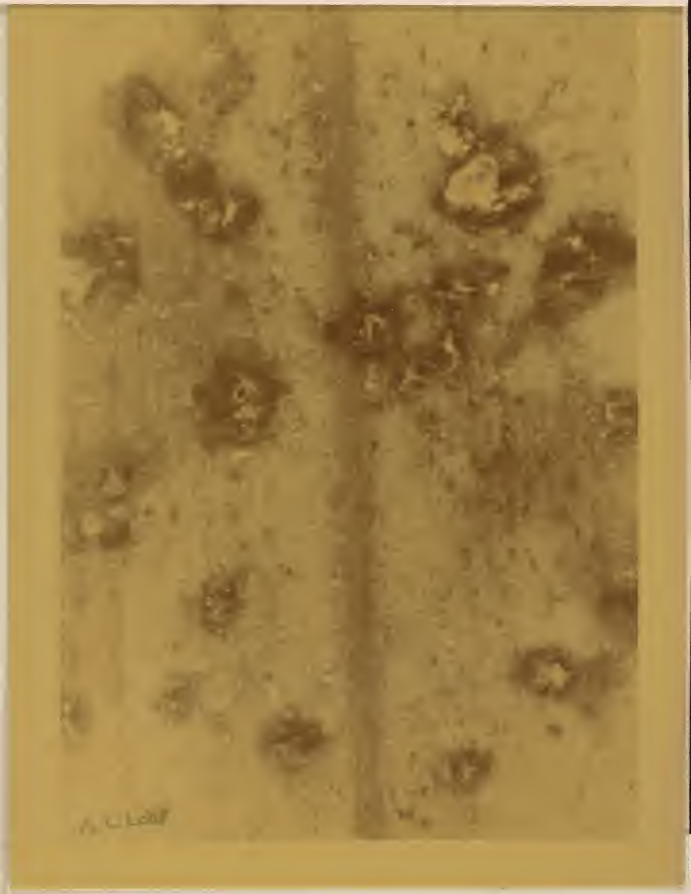
Manual of the Rusts in United States and Canada, by Dr. J. C. Arthur. p. 245.
Saccardo 23:653.

UREDO ONCIDII P. HENN. ON ZYGOPETALUM BURTI ORCHID 5

UROMYCES ABBREVIATUS ARTH. III, ON PSORALEA PHYSODES 6

URED0 GUACAE MAYOR II,
ON STANHOPEA SP. LEAF

7



URED0 NIGROPUNCTA P. HENN.,
ON LEAF OF EPIDENDRUM SP.

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Uredo guacae Mayor, on Stanhopea sp. (leaf)

Sori amphygenous or more often hypophyllous, sparse to numerous and here and there grouped but not confluent, round (about 5 mm.), swollen (pustulate), yellow brown, in the center of the pustules a yellow papillate covering of the swollen epidermis becoming ruptured, borne on yellow-brown to tawny spots, spores globose 23-26 mu in diameter to ovate 23-28 X 19-23 mu, yellowish, membrane 2-2.5 mu thick, rather loosely echinulate, germ pores obscure.

Sydow. Monographia Uredinearum V.4:504. 1924.

Uredo nigropuncta P. Henn., on Epidendrum sp. (leaf)

Uredia hypophyllous, forming irregular orange or blackish masses, 1-2 mm. across, pulverulent, cinnamon-brown, urediospores ellipsoid or obovoid, 20-25 X 24-32 mu, wall brownish-yellow, 2-3 mu thick, sparsely and coarsely verrucose-echinulate, the pores 3, equatorial; occurs on Orchidaceae.

Manual of the Rusts in United States and Canada, by Dr. J. C. Arthur. p. 392.

Chrysomyxa ledi (Alb. & Schw.) de Bary var. rhododendri (DC.) Savile, on Rhododendron leaf

Uredo and telia stages are found on the under surface of Rhododendron leaves.

Urediospores, usually termed the summer spores, are slightly ellipsoidal, yellow, and measure 15-22 X 17-28 mu when mature. The walls are irregularly thickened to give a warty appearance.

Mycelium is distributed through the leaf tissue and fills the spaces between the cells. This causes the death of leaf tissue and loss of healthy green color.

Teliospores 10-14 mu wide, not expanded towards the top, obtuse to round in shape.

Aecia found on under side of the needles of Picea excelsa, not yet known in North America.

Fungous Diseases of Plants, by Dr. Jakob Eriksson. p. 220, 1930.

North American Species of Chrysomyxa, by Dr. D. B. O. Savile, Canadian Journal of Research, C, 28:325, June 1950.

Chrysomyxa ledicola (Peck) Lagerh, on Picea sitchensis

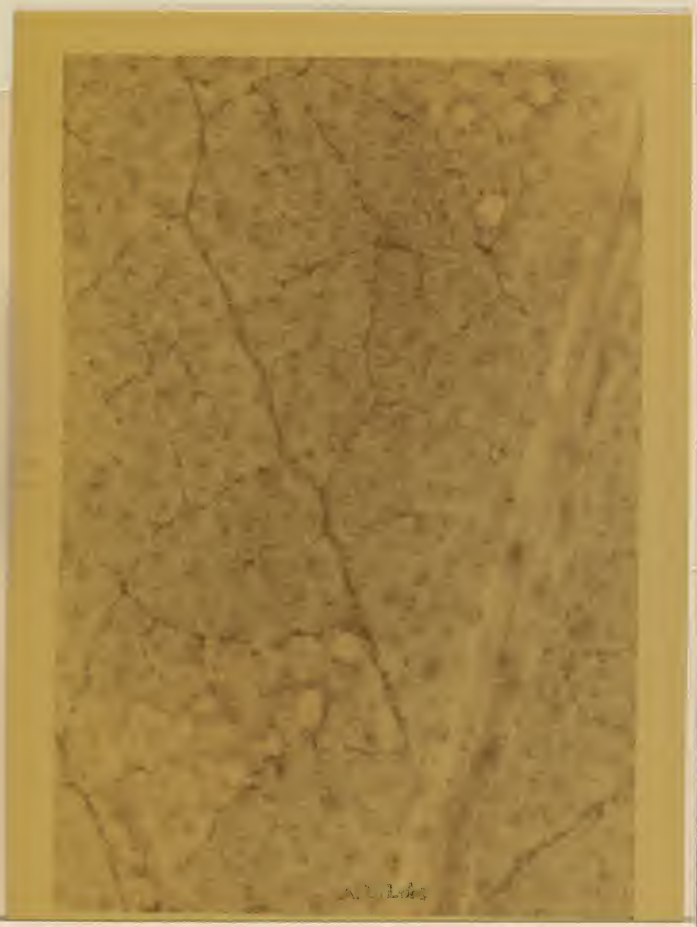
Pycnia amphigenous, punctiform, prominent. Aecia hypophyllous, with compressed, fragile peridium, the cells abutted or slightly overlapping; aeciospores broadly ellipsoid or globoid, very large, 22-40 X 27-55 mu; wall colorless, 3-6 mu thick, coarsely verrucose. In appearance the aecia pictured here closely resemble the aecia of C. ledi var. rhododendri which also occurs on leaves of species of Picea.

(Any such aecial infection of spruce in association with the genus Rhododendron should be viewed with suspicion, and specimens should be submitted for identification, since they might represent the aecial stage of C. ledi var. rhododendri, which has not yet been reported in North America.--W. H. W.)

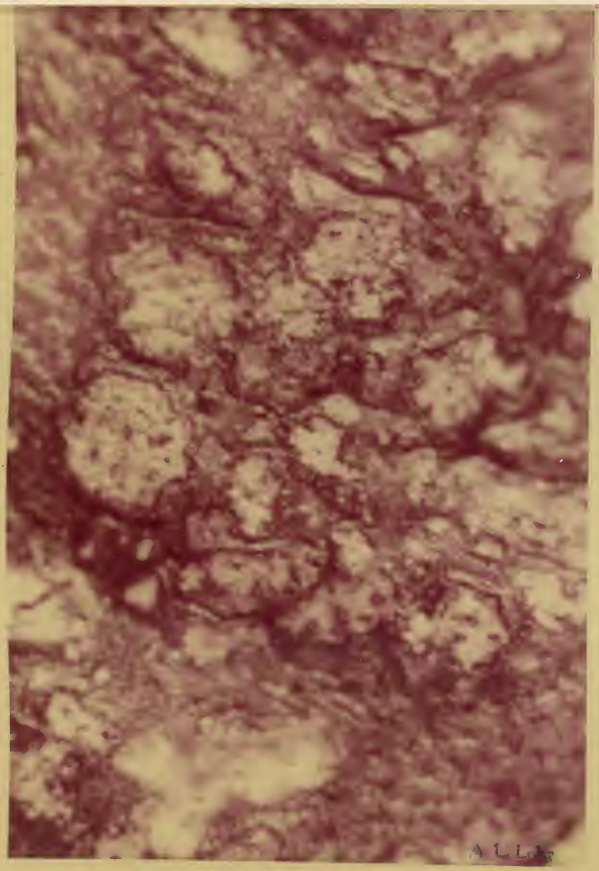
Uredia epiphyllous, on reddish-brown spots, small, pale yellowish or reddish; urediospores broadly ellipsoid or globoid, 18-29 X 26-36 mu; wall colorless, 2.5-3 mu thick, closely verrucose. Telia epiphyllous, flat, small, at first blood-red; teliospores oblong or cuboid, 10-14 X 13-18 mu, in a series 65-80 mu long; wall colorless, uniformly 1 mu thick. On Ledum decumbens and L. groenlandicum.

Manual of the Rusts in United States and Canada, by Dr. J. C. Arthur. p. 33, 1934.

CHRYSOMYXA LEDI (ALB. & SCHW.) DE BARY VAR. RHODODENDRI (DC.) SAVILE, ON RHODODENDRON LEAF 9



CHRYSOMYXA LEDICOLA (PECK) LAGERH, ON PICEA SITCHENSIS 10



CERCOSPORA ANGOLENSIS CARVALHO & MENDES
ON CITRUS SINENSIS FRUIT

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CERCOSPORA ANGOLENSIS CARVALHO & MENDES
ON CITRUS SINENSIS LEAF

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CERCOSPORA ANGOLENSIS CARVALHO & MENDES N. SP., ON CITRUS SINENSIS (LEAF AND FRUIT)

SPOTS ON LEAVES ROUND, UP TO 4 MM. IN DIAMETER, PROMINENT, SURROUNDED BY A YELLOW ZONE, ON THE UPPER SURFACE GRAY BROWN, ON THE LOWER VELVETY, ASHY GRAY, DARK BROWN, THEN BLACK; CONIDIOPHORES HYPOPHYLLOUS, DENSELY FASCICULATE, MANY-SEPTATE, 2.7-3.1 X 27-118 MU, ARISING FROM A LIGHT BROWN ERUMPENT, BROWNISH BLACK STROMA, PSEUDO-PARENCHYMATOUS, CONIDIA SUBCLAVATE, OFTEN STRAIGHT, HYALINE, 1-6 SEPTATE, 3.2-6.9 X 24-80 MU.

SPOTS ON FRUIT ROUND UP TO 2 CM. IN DIAMETER, SOMETIMES CONFLUENT, IN THE CENTER BROWNISH-BLACK, LEATHERY, RAISED, SURROUNDED BY A BROAD GREENISH BAND.

UMA NOVA ESPECIE DE CERCOSPORA EM CITRUS SINENSIS OSBECK, BY TOMAZ DE CARVALHO ET ORLANDO MENDES - BOL. DA SOC. BROT. V.27:201-202. 1953.

XANTHOMONAS CITRI (HASSE) DOWSON, ON CITRUS SINENSIS, C. AURANTIFOLIA (LEAF) AND C. MITIS (CALAMONDIN ORANGE)

THE DISEASE OCCURS ON LEAVES, TWIGS, THORNS, OLDER LIMBS AND FRUIT. LEAF LESIONS FIRST APPEAR AS SMALL, ROUND, YELLOWISH BROWN SPOTS, TRANSLUCENT, OILY, RAISED, AND USUALLY APPEARING ON THE LOWER SURFACE FIRST. THE TISSUE RUPTURES IN THE CENTER OF THE LESION GIVING A ROUGH CORKY APPEARANCE. THE SPOTS INCREASE IN SIZE TO A QUARTER OR HALF AN INCH IN DIAMETER WITH CRATER-LIKE DEPRESSIONS IN THE CENTER AND YELLOWISH BROWN TO GREEN RAISED MARGINS AND WATERY YELLOW HALOS. OLD LESIONS ARE BROWN, CORKY, HARD AND LIQUIFIED. SPOTS MAY OCCUR ON THE MIDRIB OR PETIOLE AND RESULT IN DEFOLIATION. SIMILAR ROUND SPOTS UP TO 1/4 INCH IN DIAMETER OCCUR ON THORNS AND TWIGS AND MAY GIRDLE THE LATTER. ON LARGER BRANCHES THE SPOTS ARE ROUGHER, MORE IRREGULAR AND MORE PROMINENT. LESIONS ON FRUITS HAVE MUCH THE SAME APPEARANCE AS ON THE LEAVES EXCEPT THAT THE YELLOW HALO IS USUALLY ABSENT AND CRATER-LIKE DEPRESSIONS ARE MORE NOTICEABLE. FRUIT LESIONS BECOME VERY CORKY AND OFTEN SHOW LARGE FISSURES AND CRACKS.

THE ORGANISM ENTERS THROUGH NATURAL OPENINGS OR WOUNDS, OCCUPYING THE INTERCELLULAR SPACES AND DISSOLVING THE MIDDLE LAMELLA. BACTERIA ROD-LIKE, 0.5 - 0.75 X 1.5 - 2 MU, OCCURRING IN CHAINS; MOTILE BY A SINGLE POLAR FLAGELLUM.

CITRUS CANKER IS OFTEN CONFUSED WITH LEPROSIS OR NAILHEAD RUST AND IN MANY CASES SUCH CONFUSION IS JUSTIFIABLE. BOTH DISEASES CONSIST OF BROWN, RAISED SURFACES, AND THE SIZE OF THE LESIONS IS FREQUENTLY THE SAME. CITRUS CANKER LESIONS ARE, HOWEVER, ROUGHENED, NOT GLAZED, AND HAVE THE CRATER-LIKE APPEARANCE AND THE OILY-APPEARING MARGINS PREVIOUSLY MENTIONED, WHILE LEPROSIS HAS A SMOOTH, ALTHOUGH SOMETIMES CRACKED, SURFACE, AND LACKS THE OILY MARGINS.

CANKER AND SCAB, WHICH ARE BOTH ENLARGEMENTS OF THE TISSUES, MAY BE MORE READILY CONFUSED. SCAB, HOWEVER, APPEARS AS A WART-LIKE PROJECTION FROM ONE SIDE OF THE LEAF, USUALLY WITH DISTORTION AND, IN OLDER LESIONS, IS WITHOUT THE YELLOW HALO. SPINE PUNCTURES ARE SUNKEN SPOTS IN THE TISSUES AND RARELY HAVE THE HALO SURROUNDING THEM, THUS BEING EASILY DISTINGUISHED FROM CITRUS CANKER.

MANUAL OF BACTERIAL PLANT PATHOGENS, BY CHARLOTTE ELLIOTT. P. 113. 1950.
CITRUS DISEASES AND THEIR CONTROL, BY HOWARD S. FAWCETT. P. 244-245. 1936.

XANTHOMONAS CITRI (HASSE) DOWSON ON CITRUS SINENSIS

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XANTHOMONAS CITRI (HASSE) DOWSON ON CITRUS AURANTIFOLIA LEAF

14

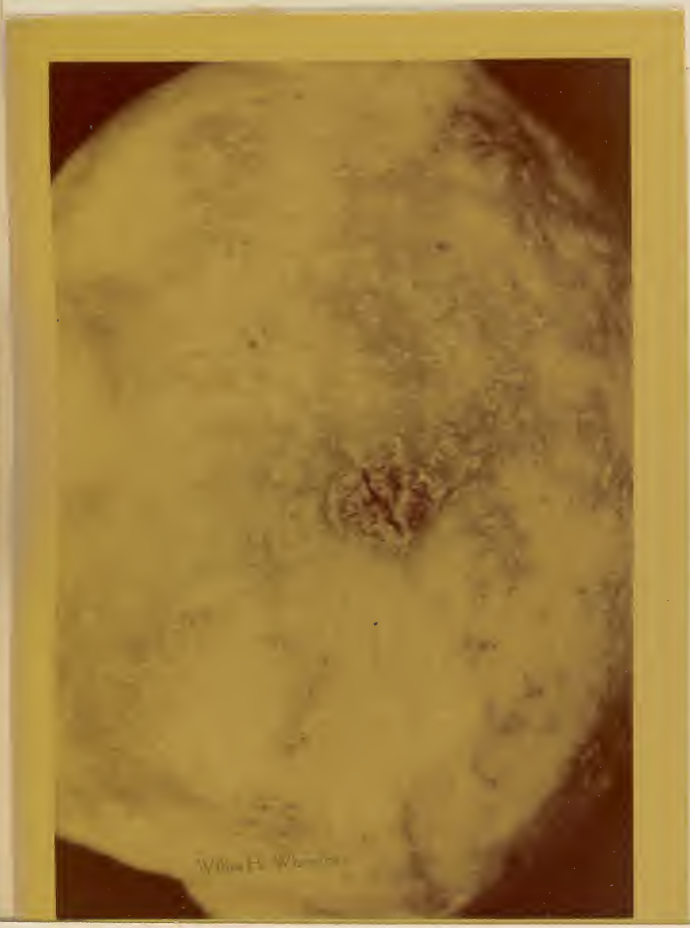
XANTHOMONAS CITRI (HASSE) DOWSON (CITRUS CANKER, ON CITRUS MITIS (CALAMONDIN ORANGE), SHOWING AN ENLARGED LESION 15

XANTHOMONAS CITRI (HASSE) DOWSON (CITRUS CANKER), ON CITRUS MITIS (CALAMONDIN ORANGE) 16

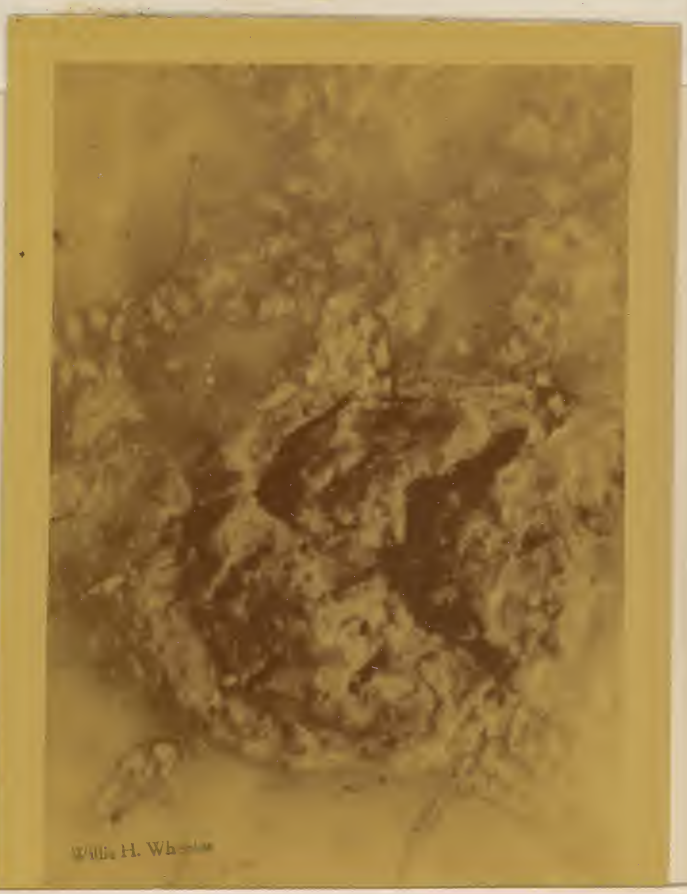
XANTHOMONAS SP.? ("CANCROSIS B"), ON CITRUS LIMON

"CANCROSIS B", AS FAR AS WE CAN DETERMINE, HAS NOT BEEN REPORTED TO INFECT GRAPEFRUIT, WHILE SWEET ORANGE IS ALMOST IMMUNE TO THE DISEASE. BOTH ARE OF COURSE QUITE SUSCEPTIBLE TO CITRUS CANKER. ASIDE FROM THE DIFFERENCE IN HOSTS, THE DISEASES ARE QUITE SIMILAR. FOR A DESCRIPTION OF THIS BACTERIA SEE XANTHOMONAS CITRI.

XANTHOMONAS SP. ? ("CANCROSIS B"), ON CITRUS LIMON 17



XANTHOMONAS SP.? ("CANCROSIS B") SHOWING AN ENLARGED LESION ON CITRUS LIMON 18



LEPROSIS OF CITRUS (NAILHEAD RUST) ON CITRUS SINENSIS STEM

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LEPROSIS OF CITRUS (NAILHEAD RUST) ON CITRUS SINENSIS FRUIT.

20

Leprosis of Citrus (Nailhead rust), on *Citrus sinensis* (Fruit and stem)

Leprosis is also known as "nailhead rust" and "scaly bark" in Florida and as "lepra explosiva" in Argentina. It occurs also in Brazil and Paraguay and in the Orient. In Florida, it is severe only on varieties of the sweet orange (*Citrus sinensis*) and less injurious on grapefruit and sour orange. In Brazil and Argentina, leaf symptoms may occur on tangerines, lemons, limes and citrons, as well as on sweet oranges.

The disease develops at first as round or oval spots on twigs, leaves, and fruit. On twigs, the spots are at first raised above the surface and are chestnut to auburn in color; later the bark is glazed, hard, brittle, and cracked, tending finally to break into scales. When the spots increase in number, they may join, forming patches of scaly and scabby bark with an effect resembling psorosis. On the fruit in Florida the spots, 1/5 to 1/2 inch in diameter, may have a chestnut brown center with a lemon yellow halo which fades imperceptibly into the normal green of immature fruit. On leaves the spots resemble those on fruit, becoming brown in color, sometimes with slightly raised concentric rings and a yellow zone in the form of a halo. Leaf spots of leprosis are rarely seen on Florida trees, but are common in Brazil, Argentina, and Paraguay, where great variation exists in the type and appearance of the spots.

Leprosis affects all portions of the tree above ground from the trunk to the smallest twigs as well as the fruit and sometimes, but rarely, the leaves.

Leprosis differs from canker in the following points: The spots on the twigs are more glazed and hard, not spongy nor so prominently raised from the surface. The spots on the fruit are not raised above the surface nor are they spongy. Leprosis seriously affects sweet orange trees but rarely grapefruit, while canker, *Xanthomonas citri*, affects both grapefruit and oranges.

In years past there has been much speculation as to the cause of the disease. Some have thought it was caused by a fungus. Others have suggested that it might be caused by a virus. On the basis of recent findings, leprosis is apparently not due to either, but rather to the feeding of *Brevipalpus* mites.

Citrus Diseases and Their Control, by H. S. Fawcett. pp. 252-260, 527-529.
Plant Disease Reporter V38, No. 3, p. 145. 1936.

Septoria citri Pass., on *Citrus limon*

The spots usually consist of small depressions or pits 1 to 2 mm. in diameter and extending not deeper than the oil glands. The bottom of the pit is usually light tan or buff, with a narrow greenish margin which becomes reddish brown as the fruit matures and colors. Some spots, dark brown in color, may attain a diameter of 4 to 10 mm. and may extend into the albedo of the rind, as is illustrated by the photograph.

Pycnidia are black, 50 to 80 mu in diameter, and contain spores 2-3 X 14-18 mu.

The Citrus Industry, by L. D. Batchelor and H. J. Webber. V.2, p. 533. 1948.
Citrus Diseases and Their Control, by Howard S. Fawcett. p. 524.

LEPROSIS OF CITRUS (NAILHEAD RUST) ON CITRUS SINENSIS FRUIT

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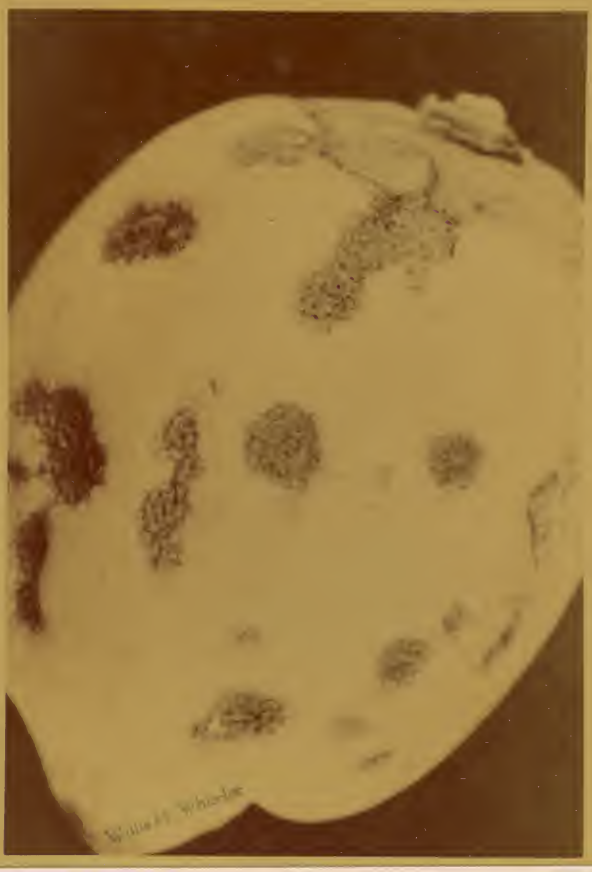
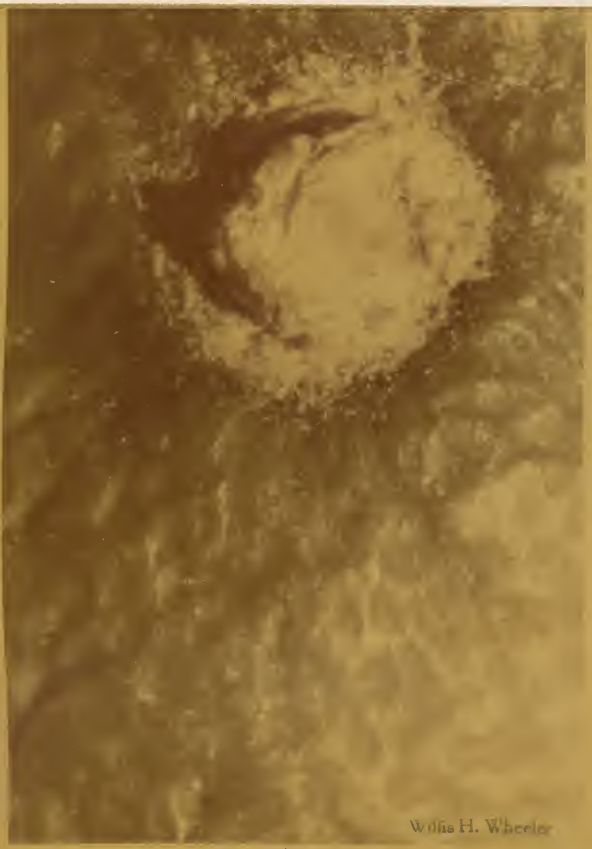
SEPTORIA CITRI PASS., ON CITRUS LIMON

22





GLOEOSPORIUM LIMETTICOLUM CLAUSEN , ON CITRUS AURANTIFOLIA. SHOWING AN ENLARGED LESION 23

ELSINOE AUSTRALIS BITANC. & JENKINS ON CITRUS SINENSIS 24

Gloeosporium limetticolum Clausen, on Citrus aurantifolia

The fungus attacks young shoots, leaves, and fruits while they are still tender. Fruits that are attacked but not shed show lesions varying from scab-like spots to deep canker-like areas over half or more of the surface. Consequently, the disease may easily be mistaken for scab. The strains that are virulent on the lime are not found on other Citrus varieties. The fungus was distinguished by Clausen (1912) from Colletotrichum gloeosporioides Penz., which it closely resembles in general form. The differences between this lime fungus and the other as given by Clausen are mainly as follows: G. limetticolum produces no setae, the acervuli are always flesh colored or salmon pink, while the other may be dark or black on dead leaves and twigs. The conidiophores of the lime fungus are hyaline throughout their entire length and arise from a loose stroma of hyaline hyphae, while the conidiophores of the other are pale, sooty at their bases, and arise from a more compact stroma. The measurements of the lime fungus G. limetticolum, as given by Clausen, are as follows: acervuli 50 to 100 mu in diameter, conidiophores 3-5 X 16-30 mu, and spores 3.5-6 X 12-20 mu.

Citrus Diseases and Their Control, by Howard S. Fawcett. p. 298. 1936.

Elsinoe australis Bitanc. & Jenkins, on Citrus sinensis

Sphaceloma australis Bitanc. & Jenkins (shown in photograph) is the imperfect stage of E. australis. This sweet-orange scab appears on the fruit as irregular or round, corky excrescences, yellow or clear chamois color, usually 1 to 3 mm. in diameter but frequently confluent and covering a large portion of the fruit. With a lens one may see on the surface of the pustules small, round protuberances 1/10 mm. in diameter, sometimes so numerous as to become confluent and cover the surface of the scab with a corky layer. These protuberances are light or deep buff or black.

The perfect stage, E. australis, is seldom encountered because it is embedded in the host tissue and when present is very difficult to find.

Citrus Diseases and Their Control, by Howard S. Fawcett. p. 547. 1936.

GREASY SPOT, ALSO KNOWN AS "BLACK MELANOSE", ON *CITRUS AURANTIUM* (LEAF), COMPARED WITH TRUE MELANOSE *PHOMOPSIS CITRI* FAWC., ON YELLOW FRAGMENT OF *CITRUS* SP. (LEAF)

BLACK MELANOSE OR GREASY SPOT IS ESPECIALLY COMMON ON GRAPEFRUIT LEAVES, ALTHOUGH IT IS FREQUENTLY FOUND ON OTHER VARIETIES. IT IS USUALLY LOCATED ON THE UNDER SIDE OF THE LEAF AND DOES NOT APPEAR TO AFFECT THE CHLOROPHYLL TO ANY EXTENT. THE SPOTS HAVE A DARK, SLIGHTLY RAISED, GREASY APPEARANCE, UNDER A SEMITRANSPARENT EPIDERMIS. THE IRREGULAR SPOTS APPEAR TO DEVELOP AFTER THE LEAF TISSUE IS MATURE AND IN THIS RESPECT DIFFER FROM TRUE MELANOSE. THE CAUSE OF GREASY SPOT IS NOT KNOWN. ABOUT 1952 SHOICHI TANKAKA AND SHUNICHI YAMADA, AFTER NUMEROUS EXPERIMENTS, REPORTED *MYCOSPHAERELLA HORII* HARA AS THE ORGANISM WHICH PRODUCES THE SYMPTOMS OF GREASY SPOT. (DESCRIPTION IN MYCOLOGIA V.9:367. 1917.)

PHOMOPSIS CITRI LESIONS HAVE THE SAME GENERAL APPEARANCE WHETHER ON LEAVES, STEMS OR FRUITS AND RESULT IN THE FORMATION OF SMALL, HARD, RAISED, REDDISH-BROWN SPOTS OR SPECKS, SCATTERED OVER THE SURFACE OF LEAVES OR FRUITS. IN GENERAL, THESE SPOTS ARE ROUND WITH A SMOOTH, GLAZED SURFACE AND ARE USUALLY BORDERED BY A LIGHTER COLORED RING. THIS ORGANISM IS DESCRIBED AS FOLLOWS: PYCNIDIA SCATTERED, OVOID, PARENCHYMATOUS, GREEN OR DARK, 200 - 450 MU IN DIAMETER, ERUMPENT, THICK-WALLED, TOP EASILY BROKEN AWAY LEAVING SPORES EXPOSED; OSTIOLE 35 - 45 MU; SPORES OVATE OR FUSIFORM, OFTEN FLATTENED ON ONE SIDE, HYALINE, OFTEN 1 - 3 GUTTULATE, 2.5-4 X 5-9; CONIDIOPHORES 1.5 X 12-15 MU; STYLOSPORES 0.75-1.5 X 20-30 MU, EASILY DETACHED, CURVED AT ONE END. ON DEAD TWIGS, AND VERY INFREQUENTLY ON FRUIT ROTTED BY THE FUNGUS, WHICH GAINS ENTRANCE THROUGH THE STEM END. THE PYCNIDIA-LIKE SPOTS (SEE PHOTOGRAPH) ON LEAVES, TWIGS, AND FRUIT ARE GUM-FILLED LESIONS, RESEMBLING PYCNIDIA, BUT CONTAIN NO SPORES.

THE ASCOGENOUS, OR PERFECT STAGE, IS KNOWN AS *DIAPORTHE CITRI*.

MANUAL OF PLANT DISEASES, BY DR. F. D. HEALD. P. 709. 1933.
PLANT DISEASE FUNGI, BY F. L. STEVENS. P. 342. 1925.

SEPTORIA DEPRESSA MCALP., ON *CITRUS SINENSIS* VAR. "VALENCIA"

DEPRESSIONS ON SKIN OF FRUIT, BROWNISH TO BLACKISH, IRREGULARLY CIRCULAR, GLISTENING WHEN FRESH, MAY BE EITHER DARK TOWARDS THE CENTER AND RUDDY-BROWN TOWARDS THE CIRCUMFERENCE, OR THE REVERSE, VARYING IN SIZE FROM 1/4 INCH TO 1 INCH IN DIAMETER, AND SEVERAL MAY RUN TOGETHER. PYCNIDIA MINUTE, PUNCTIFORM, IMMERSED, BLACK, IN SMALL GROUPS, GLOBULAR TO SUB-GLOBOSE, OPENING BY PORE, ABOUT 112 MU IN DIAMETER. CONIDIA HYALINE, SUB-CYLINDRICAL, STRAIGHT OR SLIGHTLY CURVED, USUALLY 1-SEPTATE, SOMETIMES SLIGHTLY CONSTRICTED AT SEPTUM, WITH ROUNDED ENDS, AVERAGE 2 X 15 MU, BUT VARYING IN SIZE FROM 1.5-3.5 X 13-19 MU.

FUNGUS DISEASES OF CITRUS TREES IN AUSTRALIA, BY D. MCALPINE. P. 83. 1899.

GREASY SPOT, ALSO KNOWN AS "BLACK MELANOSE", CAUSE UNKNOWN, ON CITRUS AURANTIUM LEAF. COMPARED WITH MELANOSE PHOMOPSIS CITRI FAWC., ON YELLOW FRAGMENT OF CITRUS LEAF

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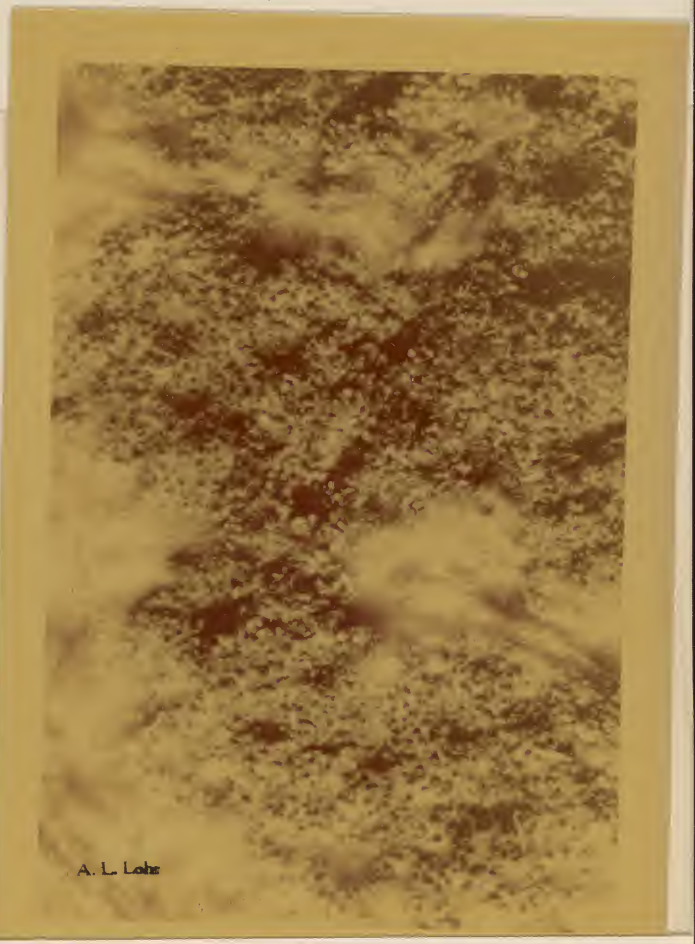
SEPTORIA DEPRESSA McALP., ON CITRUS SINENSIS VAR "VALENCIA"

26



ELSINOE FAWCETTII BITANC. & JENKINS ON CITRUS LIMON

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ELSINOE FAWCETTII BITANC. & JENKINS, SHOWING AN ENLARGED SECTION OF THE LESIONS ON CITRUS LIMON

28

ELSINOE FAWCETTI BITANC. & JENKINS, ON CITRUS LIMON (FRUIT) AND CITRUS AURANTIUM (LEAF)

THE THREE PHOTOGRAPHS ILLUSTRATE SPHACELOMA FAWCETTI JENKINS, WHICH IS THE IMPERFECT STAGE OF E. FAWCETTI. THIS SOUR-ORANGE SCAB OR VERRUCOSIS IS ESPECIALLY SEVERE ON SOUR ORANGE AND IS ALSO COMMERCIALLY IMPORTANT ON LEMON, GRAPEFRUIT, SATSUMA, AND CERTAIN OTHER VARIETIES.

LESIONS ON THE FRUIT APPEAR EITHER AS CORKY PROJECTIONS WITH DISTINCT DISTORTION OF THE FRUIT OR AS IRREGULAR, SLIGHTLY RAISED SCABS WITHOUT MUCH FINAL DISTORTION.

LESIONS ON THE LEAVES BEFORE THEY HAVE UNFOLDED ARE SMALL, SEMITRANSLUCENT DOTS, SOON BECOMING SHARPLY DEFINED PAPILLARY ELEVATIONS, FLAT OR SOMEWHAT DEPRESSED AT THE CENTER. THE COLOR OF THE YOUNG LESIONS IS OFTEN SALMON BUFF OR FLESH OCHER. THE CENTRAL AREAS OF SLIGHTLY OLDER LESIONS ARE OFTEN DRAB, OWING TO THE FORMATION OF TINY TUFTS, FORMED OF CONIDIOPHORES AND SPORES OF THE PATHOGEN. WITH THE HARDENING OF THE LEAF, THE LESIONS BECOME ROUGH, CORKY, AND WART-LIKE AND OCCASIONALLY DISINTEGRATE TO SOME EXTENT; THEY ARE THEN DULL TAN IN COLOR. LESIONS OCCUR ON BOTH SURFACES OF THE LEAF BEING MORE NUMEROUS ON THE UNDERSIDE.

SCAB AFFECTS TWIGS OF ONLY THE MOST SUSCEPTIBLE VARIETIES AND ON VERY SUCCULENT GROWTH, SUCH AS RAPIDLY GROWING NURSERY STOCK.

ACERVULI SOLITARY OR CONFLUENT, SUBCIRCULAR, CHIEFLY LESS THAN 1 MM. IN DIAMETER, ON LEAVES INTRAEPIDERMAL, BECOMING ERUMPENT, PSEUDOPARENCHYMATOUS AT BASE, MAY ALSO EXTEND TO THE UNDERLYING HOST TISSUE, IN THIS REGION MAINLY PLECTENCHYMATOUS; CONIDIOPHORES ARISING PERPENDICULARLY FROM SURFACE STROMA, STANDING CLOSE TOGETHER, CYLINDRICAL, APEX SHARP POINTED, BLUNT APICULATE OR OBTUSE, ONE TO THREE CELLED, HYALINE, BUT MAY BECOME DUSKY, PRINCIPALLY 3-4 X 12-22 MU; CONIDIA ACROGENOUS, ALSO PLEUROGENOUS (OBSERVED IN CULTURE), OBLONG, ELLIPSOID, SLIGHTLY RENIFORM OR OVOID, RANGING FROM 2-5 X 5-10 MU, USUALLY 2.5-3.5 X 6-8.5 MU, OFTEN BIGUTTULATE, ONE OIL DROP AT EACH END, CONTINUOUS, HYALINE, SOMETIMES BECOMING ELONGATED OR SWOLLEN AND ONE SEPTATE AND DUSKY.

THE PERFECT STAGE IS DESCRIBED AS FOLLOWS: ASCOMATA MORE OR LESS SCATTERED, PULVINATE, DARK BROWN, CIRCULAR TO ELLIPTICAL, 36-80 X 38-106 MU; EPITHECIUM COMPOSED OF DARK-COLORED PSEUDOPARENCHYMA, 5-9 MU THICK; ASCI 1 TO 20 OR MORE IN A SINGLE ASCOMA, DISTRIBUTED IN THE LIGHTER COLORED STROMATIC REGION BENEATH THE EPITHECIUM, GLOBOSE TO OVOID, 12-16 MU IN DIAMETER, WALL OF UNEXPANDED ASCUS THICKENED IN UPPER PORTION; ASCOSPORES HYALINE, OBLONG-ELLIPTICAL, 5 X 10-12 MU, TWO TO FOUR CELLED, USUALLY CONSTRICTED AT THE MIDDLE SEPTUM, UPPER HALF OF SPORE THICKER AND SHORTER, LOWER HALF THINNER AND LONGER; EPISPORE 1.2 MU.

NOTE: SINCE THE SYMPTOMS OF THE SWEET-ORANGE SCAB AND THOSE OF THE SOUR-ORANGE SCAB ARE RATHER SIMILAR, ONE IS OFTEN MISTAKEN FOR THE OTHER. EXCEPT FOR CULTURE WORK, THE MOST RELIABLE METHOD OF DISTINCTION IS TO KNOW THAT SWEET-ORANGE SCAB IS ONLY FOUND ON SWEET ORANGES, TANGERINES, AND SWEET LIMES.

CITRUS DISEASES AND THEIR CONTROL, BY HOWARD S. FAWCETT. PP. 530-536.

PHOMA CITRICARPA McALP., ON CITRUS RETICULATA (MANDARIN ORANGE)

THE PHOTOGRAPH ILLUSTRATES CITRUS BLACK SPOT ON DRIED PEEL. THIS ORGANISM IS FOUND MAINLY ON THE FRUITS, ALTHOUGH IT OCCASIONALLY AFFECTS THE LEAVES AND TWIGS BUT NOT THE LARGER BRANCHES. SMALL REDDISH-BROWN SPOTS AT FIRST APPEAR ON THE SURFACE OF THE FRUIT; LATER, THESE SPOTS TURN DARKER, BECOMING SOMETIMES ENTIRELY BLACK. THE SPOT MAY BE ONLY 1/25 TO 1/12 INCH (1 - 2 MM.) IN DIAMETER, BUT WITH TIME THE AREA MAY SPREAD TO FROM 1/3 TO 2/5 INCH (8 - 10 MM.) IN DIAMETER. AS THE SPOT MATURES, A REDDISH-BROWN RAISED MARGIN FORMS AROUND THE OUTER EDGES, WHILE THE CENTER SOMETIMES BECOMES DEPRESSED AND ASSUMES A LIGHT TAN OR BROWNISH COLOR. LATER, STILL FURTHER SINKING TAKES PLACE OFTEN EXTENDING FROM 1 TO 2 MM. INTO THE SKIN TISSUE. AT THE SAME TIME THE PITS DARKEN IN COLOR AT THE EDGES. PYCNIDIA SOMETIMES SHOW IN THE DEPRESSED, LIGHT-COLORED AREA; THEY ARE BLACK AND A MERE FRACTION OF A MILLIMETER IN DIAMETER, SOLITARY OR IN GROUPS, SOMETIMES CIRCULARLY ARRANGED, DARK-BROWN BY TRANSMITTED LIGHT, PUNCTIFORM, GLOBULAR, ERUMPENT; PORE ABOUT 20 MU IN DIAMETER, ALTHOUGH IT MAY BE SOMEWHAT ELLIPTICAL; CONIDIOPHORES HYALINE, SLENDER, ABOUT 6 MU LONG; CONIDIA HYALINE, SOMEWHAT VARIABLE IN SHAPE, ELLIPTICAL TO OVATE OR EVEN PEAR-SHAPED, WITH CONSPICUOUSLY GRANULAR CONTENTS, OCCASIONALLY BEARING A HYALINE APPENDAGE AT THE APEX, 4.5-6 X 8-11 MU, AVERAGE 5.5 X 9.5 MU.

WHILE THE IMPERFECT STAGE OF P. CITRICARPA HAD LONG BEEN KNOWN, IT WAS NOT UNTIL 1948 THAT ANY WORKER OFFERED A DESCRIPTION OF A POSSIBLE PERFECT STAGE. AT THAT TIME TEMPLE B. KIELY DESCRIBED THE ASCIGEROUS FORM OF THE FUNGUS UNDER THE NAME GUIGNARDIA CITRICARPA. HER DESCRIPTION FOLLOWS:

PERITHECIA SOLITARY 125 - 135 MU, ALSO IN GROUPS OF TWO 220 - 240 MU AND THREE, 340 - 360 MU. PERITHECIAL WALL 20 - 22 MU THICK. CARBONACEOUS DARK BROWN BY TRANSMITTED LIGHT, GLOBOSE, DEVELOPING FROM A PYCNIDIO-SCLEROTIUM. SUB-EPIDERMAL, FINALLY ERUMPENT, NO STROMA PRESENT NOR DISTINCT BEAK, BUT AN OSTIOLE 14-16 MU IN DIAMETER AT MATURITY. ASCI 12-15 X 50-85 MU, 45 TO 60 IN NUMBER ARISING FROM THE BASE OF THE PERITHECIUM, CLAVATE; CYLINDRICAL, EIGHT SPORED, UNISERIATE CHANGING TO BISERIATE AT MATURITY. ASCOSPORES, HYALINE TO GRANULAR GRAY, USUALLY WITH ONE LARGE CENTRAL GUTTULE AT MATURITY. NON-SEPTATE BUT OCCASIONALLY WITH SEPTUM NEAR ONE END OF THE ASCOSPORE, 3.3- X 8-17.5 MU, WITH A SMALL ROUND CLEAR GELATINOUS CAP AT EACH END. PARAPHYSES AND PERIPHYSES ABSENT. OCCURRING ON BOTH SURFACES OF DECAYING LEAVES OF CITRUS, NEVER ON THE FRUITS.

IT IS QUITE UNLIKELY THAT INSPECTORS WILL ENCOUNTER PERITHECIA OF THIS FUNGUS WHICH ONLY OCCUR ON FALLEN LEAVES.

CITRUS DISEASES AND THEIR CONTROL, BY HOWARD S. FAWCETT. P. 525. 1936.

FUNGUS DISEASES OF CITRUS TREES IN AUSTRALIA, BY D. McALPINE. P. 81. 1899.

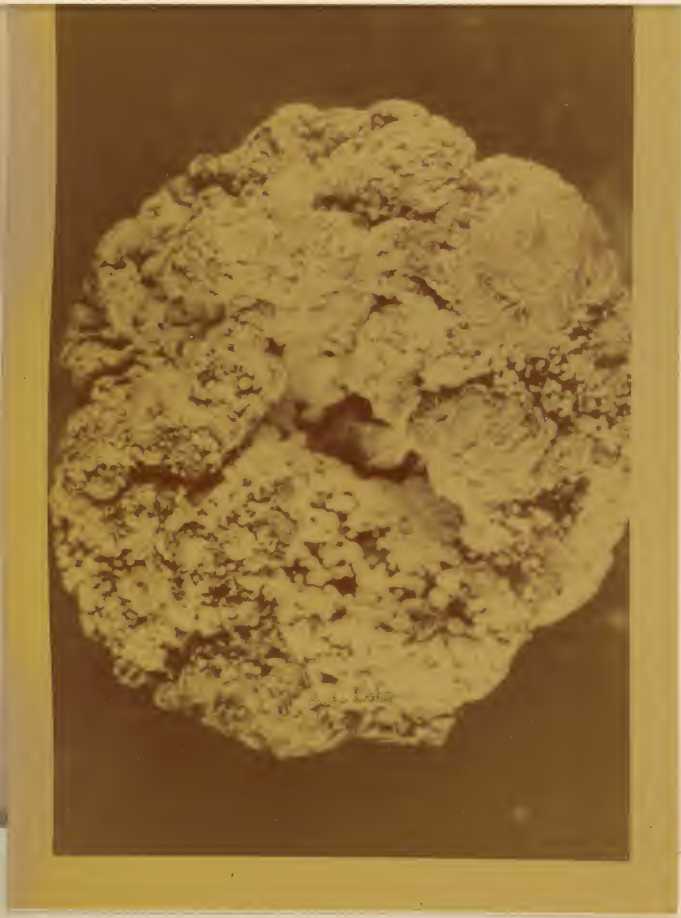
PRELIMINARY STUDIES ON GUIGNARDIA CITRICARPA N. SP., THE ASCIGEROUS STAGE OF PHOMA CITRICARPA McALP. AND ITS RELATION TO BLACK SPOT OF CITRUS, BY TEMPLE B. KIELY, PLANT PATHOLOGIST, N. S. WALES, DEPT. OF AGRICULTURE. P. 259. 1948.

ELSINOE FAWCETTII BITANC. & JENKINS ON CITRUS AURANTIUM LEAF

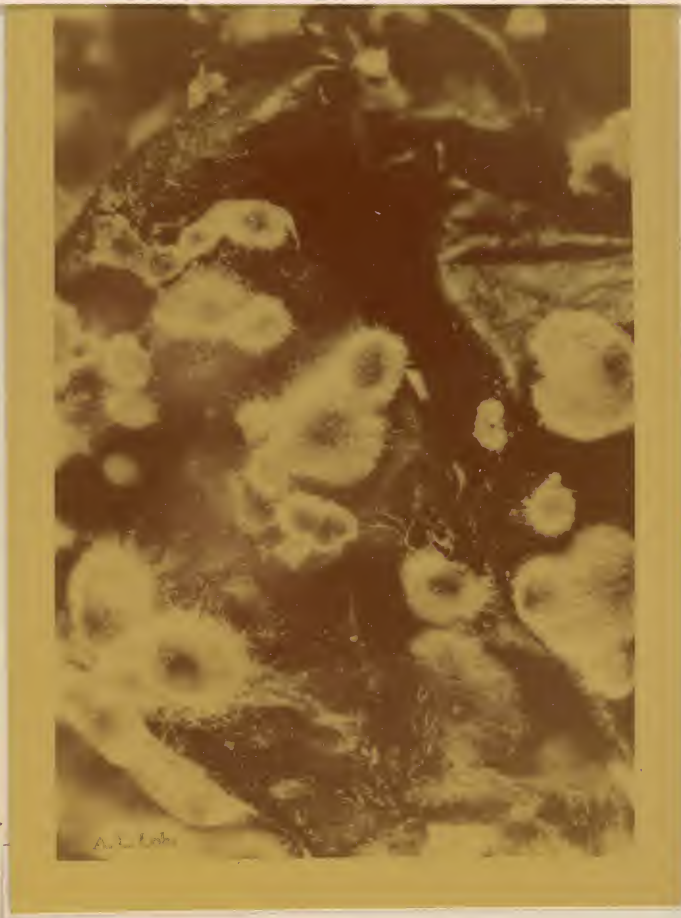
29

PHOMA CITRICARPA McALP., ON CITRUS RETICULATA (MANDARIN ORANGE)

30



MONILINIA FRUCTIGENA (ADERH. & RUHL.) HONEY (BROWN ROT OF APPLE FRUIT) ON MALUS SYLVESTRIS



MONILINIA FRUCTIGENA (ADERH. & RUHL.) HONEY SHOWING ENLARGED CUSHIONS ON MALUS SYLVESTRIS

MONILINIA FRUCTIGENA (ADERH. & RUEHLE) HONEY, ON MALUS SYLVESTRIS AND PYRUS COMMUNIS

THIS ORGANISM IS FOUND PRIMARILY ON THE FRUIT, BUT IT MAY EXTEND FROM AN INFECTED FRUIT INTO THE SPUR OR BRANCH TO CAUSE A CANKER.

THE FUNGUS IS RECOGNIZED BY THE CUSHION-LIKE TUFTS WHICH APPEAR ON THE INFECTED ORGANS; THEY ARE YELLOWISH AND USUALLY ABOUT 1/8 INCH ACROSS. EACH FRUCTIFICATION CONSISTS OF A DENSE MASS OF FUNGAL HYPHAE TERMINATING IN CHAINS OF OVAL OR LEMON-SHAPED SPORES, ALMOST COLORLESS WHEN EXAMINED INDIVIDUALLY UNDER A MICROSCOPE. THE INFECTED FRUIT GRADUALLY SHRIVELS AND BECOMES "MUMMIED".

THE CUSHION-LIKE TUFTS PRODUCE SPORES (CONIDIA) WITH GREAT RAPIDITY DURING SPRING AND SUMMER. THEY ARE VERY LIGHT AND POWDERY, AIR BORNE, AND THUS RAPIDLY SPREAD. CONIDIA MEASURE 9-15 X 12-34 MU (AVERAGE ABOUT 13 X 22 MU).

THE PERFECT STAGE OF THE FUNGUS GROWS OUT FROM MUMMIED FRUIT WHICH HAVE BEEN LYING ON THE GROUND FOR SOME TIME. THE FRUITING BODIES, KNOWN AS APOTHECIA, ARE SHAPED LIKE A STALKED CUP AND PRODUCE ASCI ON THE INNER LINING. THE STALK IS 1/2 - 1 CM. IN LENGTH, THE DISK AT FIRST CUPFORMED, LATER FUNNEL-SHAPED, YELLOW-BROWN TO GREY-BROWN, 2.5 - 7 MM. IN DIAMETER. ASCI CYLINDRIC, AVERAGING 10 X 156 MU; THE PARAPHYSES ABOUT 2 MU BROAD, A TRIFLE LONGER THAN THE ASCI. THE ASCOSPORES ARE HYALINE, UNICELLULAR, ELLIPSOID, POINTED AT THE ENDS, 6.5 X 12.2 MU.

BECAUSE OF THE TENDENCY OF THIS FUNGUS TO MOVE FROM THE INFECTED FRUIT INTO SPUR TWIGS AND LATER INTO BRANCHES TO FORM CANKERS, THE NURSERY STOCK, PLANT, AND SEED QUARANTINE No. 37 PROHIBITS IMPORTATIONS OF HOST GENERA FROM COUNTRIES WHERE THE DISEASE OCCURS, EXCEPT PROPAGATING MATERIAL OF CERTAIN VEGETATIVELY REPRODUCED UNDERSTOCKS WHICH ARE NOT ALLOWED TO FRUIT.

DISEASES OF FRUIT AND HOPS, BY DR. H. WORMALD. PP. 58-59. 1945.

FRIESIA - NORDISK MYKOLOGISK TIDSSKRIFT BIND III HEFTE 2. KØBENHAVN 1945 - DENMARK, BY GUDRUM JOHANSEN. P. 114.

MYCOSPHAERELLA CATTLEYAE CASH & WATSON, ON EPIDENDRUM RADICANS

PERITHECIA HYPOPHYLLOUS, IMMERSED, DENSELY AGGREGATED IN PALE ROUND OR ELLIPTICAL SUNKEN SPOTS 1 - 3 CM. IN DIAMETER OR SOMETIMES CONFLUENT, AND SURROUNDED BY A HEAVY BROWN MARGIN USUALLY GRAY ABOVE AND BROWN BENEATH, DARK BROWN, SUBGLOBOSE, 90-150 MU IN DIAMETER AND HEIGHT WITH WALL CONSISTING OF SEVERAL LAYERS OF BROWN THICK-WALLED CELLS AND INCONSPICUOUS OSTIOLE; ASCI NUMEROUS, CLAVATE-CYLINDRICAL, ROUNDED AT THE APEX AND NARROWED TO A SHORT PEDICEL, OCCASIONALLY SOMEWHAT MEDIANLY CONSTRICTED WITH FOUR SPORES CROWDED AT EACH END, 8 SPORED, 7-11 X 45-66 MU; ASCOSPORES IRREGULARLY BISERIATE, HYALINE, FUSOID TO NARROW CLAVATE, STRAIGHT OR CURVED, ACUTE AT THE ENDS, 4 GUTTULATE TO 1-SEPTATE, NOT CONSTRICTED, 2-3 X 13-17 MU; PARAPHYSOIDS SUBHYALINE.

SOME FUNGI ON ORCHIDACEAE, BY EDITH K. CASH AND ALICE J. WATSON. MYCOLOGIA V.47, NO. 5, P. 729, SEPTEMBER-OCTOBER 1955.

MYCOSPHAERELLA CATTLEYAE CASH & WATSON (UNPUBLISHED) N.SP.& PESTALOTIA SP. ON EPIDENDRUM RADICANS, SHOWING TOP AND UNDERSIDE OF LEAF. 33

MONILINIA FRUCTIGENA (ADERH. & RUHL.) HONEY ON MALUS SYLVESTRIS & PYRUS COMMUNIS 34

OMPHALIA FLAVIDA (CKE.) MAUBL. & RANGEL, ON COFFEA SP. 35

COLLETOTRICHUM GRISEUM HEALD & WOLF ON EUONYMUS SP. 36

Omphalia flavida (Cke.) Maubl. & Rangel, on Coffea sp.

Omphalia flavida is a Hymenomycete (toadstool forming) of peculiar interest in that: (1) it is a parasite which is able to attack the leaves of a great variety of plants (although coffee is its chief host); (2) it reproduces itself not only by means of basidiospores but also by means of gemmae of unique structure (the so-called stilbum-heads); and (3) its mycelium is luminous.

The disease is characterized by small spots, circular in outline, but sometimes ovate along the veins, at first dark brown, then becoming light tan. The spots are usually about 6 mm. in diameter, although many of the older ones are 12 to 13 mm. On the upper surface of many of the spots and also to some extent on the lower surface may be seen hair-like projections from 1 to 4 mm. long of a yellowish color, each bearing at the end a yellow head so that they resemble minute pins. This is a vegetative reproductive stage of the fungus.

The tiny yellow pin-like fruiting structures projecting from the surface of the leaf-spots are the so-called stilbum-bodies shown in the photograph. A stilbum-body never produces any spores; but, when fully formed, its head, often called a stilbum-head or gemma, is readily detachable. The fungus is distributed when the heads at the ends of the filaments are caught by the wind or raindrops and are carried to nearby leaves. The heads soon fasten to the leaves on which they happen to fall by the numerous mycelial threads which are sent out at the point of contact. Within less than a week, dark brown circular spots are formed and new stilbum-heads are produced.

The name Stilbum flavidum Cke. was incorrectly applied to the imperfect stage; however, it has nothing to do with the genus Stilbum but is merely a stage of the fungus now correctly called Omphalia flavida. The perfect stage produces a toad-stool-like body measuring 1.5 - 2.5 mm. in diameter, with few gills. Basidia 5 X 14-17.4 mu; spores minute, 2.5-3 X 4-5 mu. Under natural conditions this form rarely develops.

The mycelium emits a bluish-white light, both night and day as long as it continues growing, and only ceases when the mycelium has become old and exhausted.

Researches on Fungi V.6, by A. H. Reginald Buller. 1934.

Colletotrichum griseum Heald & Wolf, on Euonymous sp.

This is one of the most common diseases of Euonymous. It forms on the leaves indefinite-margined, yellow blotches 1 - 4 mm. in diameter. These increase in size until the diseased areas are sometimes 8 - 10 mm. across, and a definite brown elevated border is formed, when the center of the spot becomes gray. Scattered over this gray area are numerous black acervuli either zonate or more or less scattered, usually concentrically arranged, 250 mu in diameter. The twigs and larger branches are also affected, resulting in the formation of gray cankers 1 - 8 mm. in diameter.

Fruiting bodies described by authors as follows: "setae of acervuli numerous, brown, cylindric, often tapering, 5 X 40-60 mu; conidia straight or slightly curved, granular, guttulate, hyaline, rarely unequally 1 septate, 4 X 14-17 mu." (Colletotrichum spores are usually nonseptate but sometimes become septate before germination.)

New Species of Texas Fungi, by F. D. Heald & F. A. Wolf - Mycologia V.3:11. 1911.

SPHACELOMA PERSEAE JENKINS, ON PERSEA AMERICANA (AVOCADO)

LESIONS GENERALLY BROWN TO ALMOST BLACK, UP TO 3 MM. IN DIAMETER; CONIDIAL FRUCTIFICATIONS, ACERVULI AT FIRST, WITH FURTHER DEVELOPMENT CONSTITUTING SPORODOCHIA OR MORE OR LESS FREE CONIDIOPHORE TUFTS, SCATTERED TO EFFUSE, IN MASS, DARK OLIVE OR LIGHT BROWNISH OLIVE, 25-70 MU IN LENGTH; CONIDIOPHORES AT FIRST 1-2-CELLED, OFTEN ABOUT 12 MU HIGH BY 2-7 MU AT BASE, TAPERING, OR ACUTE, TO TRUNCATE AT APEX, ARISING FROM HYALINE INTRA-EPIDERMAL HYPHAE OR FROM PROSENCHYMATOUS STROMA, PALISADED, OR RUPTURING THE EPIDERMIS INCREASING IN LENGTH BY CONTINUED GROWTH OR BY CONIDIA REMAINING IN SITU AND DEVELOPING AS A PART OF THE CONIDIOPHORES, OFTEN 25 TO 50 MU LONG, REACHING 100 MU, MORE OR LESS DIVERGENT, CONTINUOUS TO SEVERAL SEPTATE, STRAIGHT OR GENICULATE, USUALLY SIMPLE, SOMETIMES DENTICULATE, APICAL REGION OFTEN PALER THAN REST OF CONIDIOPHORE; CONIDIA ACROGENOUS OR PLEUROGENOUS, AT TIMES SEVERAL PRODUCED FROM THE SAME POINT, HYALINE OR COLORED, CLEAR OR GRANULAR, SPHERICAL TO CYLINDRICAL, 2-5 X 2-30 MU; HYALINE CONIDIA OVOID OR OBLONG-ELLIPTICAL, OFTEN 3-4 X 5-8 MU, SOMETIMES BIGUTTULATE, CONTINUOUS, AT LEAST WHEN FIRST FORMED; ELONGATE COLORED CONIDIA 1-6-CELLED, REACHING 3-5 X 30 MU, OFTEN 1-2-CELLED, 12-20 MU LONG; CONIDIA SOMETIMES GREATLY ENLARGED OR SWOLLEN, SWOLLEN CONIDIA AT TIMES MURIFORM; GERMINATION BY HYALINE SPROUT CONIDIA OR BY GERM TUBES, OFTEN PRODUCED APICALLY OR SUBAPICALLY BUT ALSO LATERALLY.

THE AVOCADO-SCAB ORGANISM, BY DR. A. E. JENKINS - PHYTOPATHOLOGY V.24:84-85. 1934.

CERCOSPORA PURPUREA CKE., ON PERSEA AMERICANA (AVOCADO)

THE FUNGUS IS DESCRIBED AS FOLLOWS: STROMATA DARK TO BLACK, GLOBOSE TO IRREGULAR, 15-125 MU IN DIAMETER; FASCICLES FAIRLY TO EXTREMELY DENSE AND COMPACT; CONIDIOPHORE PALE TO MEDIUM DARK OLIVACEOUS-BROWN, DARK IN MASS, UNIFORM IN WIDTH AND COLOR, MULTI-SEPTATE, RARELY BRANCHED, SLIGHTLY GENICULATE, STRAIGHT TO UNDULATE, SMALL SPORE SCAR AT ROUNDED TIP 3-4.5 X 20-200 MU; CONIDIA OBCLAVATE-CYLINDRICAL, PALE OLIVE, LONG OBCONIC ... TRUNCATE BASE, OBTUSE TO SUBACUTE TIP INDISTINCTLY 1-9 SEPTATE, STRAIGHT TO CURVED, 2-4.5 X 20-100 MU.

A MONOGRAPH OF THE FUNGUS GENUS CERCOSPORA, BY CHARLES CHUPP. PP. 275-276. 1953.

SPHACELOMA PERSEAE JENKINS ON PERSEA AMERICANA (AVOCADO)

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CERCOSPORA PURPUREA CKE., ON PERSEA AMERICANA (AVOCADO)

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CLADOSPORIUM HERBARUM (PERS.) LK.
ON PYRUS COMMUNIS

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SPHACELOMA SP. ON STEM OF
GLYCINE MAX (SOYBEAN)

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CLADOSPORIUM HERBARUM (PERS.) LK., ON PYRUS COMMUNIS

C. HERBARUM = CONIDIAL STAGE OF MYCOSPHAERELLA TULASNEI JACZ.

CONIDIA ARE OF TWO KINDS: (1) = (CLADOSPORIUM HERBARUM), TUFTS DENSE, FORMING A VELVETY BLACKISH-OLIVE, EFFUSED PATCH, CONIDIOPHORES ERECT, SEPTATE, RARELY BRANCHED, OFTEN NODOSE OR KEELED; CONIDIA OFTEN IN CHAINS OF 2 OR 3, SUBCYLINDRIC PALE-OLIVE, 1 TO 3 SEPTATE 4-7 X 10-15 MU. (2) = (HORMODENDRUM CLADOSPORIODES SACC.), HYPHAE ERECT, SIMPLE BEARING APICALLY OR LATERALLY A TUFT OF SMALL, ELLIPTIC, CONTINUOUS, BROWN CONIDIA IN SIMPLE OR BRANCHED CHAINS.

PERITHECIA SUBGLOBOSE, MINUTE; ASCI CYLINDRIC FUSOID; SPORES OBLONG, RATHER POINTED, UPPER CELL IN THE ASCUS SOMEWHAT LARGER THAN THE OTHER 6.5 X 28 MU.

PLANT DISEASE FUNGI, BY F. L. STEVENS. PP. 175-176. 1925.

Sphaceloma sp., on *Glycine max* (Soybean)

In 1947 an unreported scab disease was found in Japan on soybeans. In the field, leaves, stems and pods were affected. In severe cases of pod infection seeds failed to develop. The disease was named "Kokuto-byo" (scab disease) by the Japanese.

Lesions on leaves, stems, and pods are slightly raised above the surrounding normal tissue. On leaves they are circular to irregular, frequently visible on both leaf surfaces, commonly "vinaceous buff", often fading to "pale drab gray", minute to about 4 mm. in diameter. Spots on stems range from minute to elliptical-elongate areas generally "vinaceous buff", sometimes with reddish brown margins, reaching at least 1 cm. in length or 2 cm. when confluent. On pods young lesions are generally red to reddish brown, upon maturity becoming "dark olive" to black, with paler centers and reddish brown margins.

The symptoms of this scab on soybean pods are comparable to those on lima beans.

Sphaceloma Scab, A New Disease of Soybeans Discovered by Plant Pathologists in Japan, by Dr. Anna E. Jenkins. Plant Disease Reporter, V.35, No. 2, pp. 110-111. Feb. 15, 1951.

SPHACELOMA SP. ON GLYCINE MAX (SOYBEAN) LEAF

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A. L. Lohr

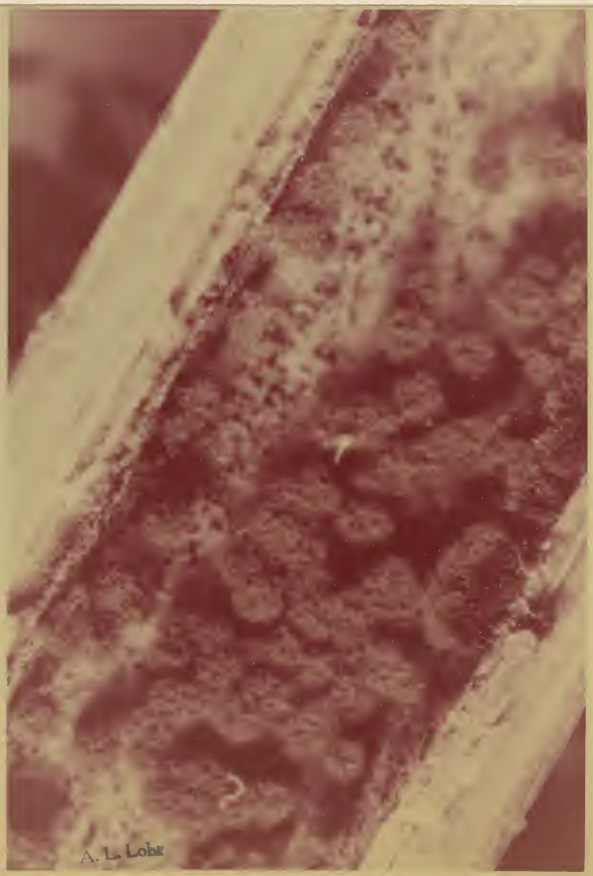
SPHACELOMA SP., ON GLYCINE MAX (SOYBEAN) SHOWING AN ENLARGED SECTION OF LEAF

42

A. L. Lohr

CEREBELLA ANDROPOGONIS CES., ON TRICHOLAENA REPENS

43



CHAETOMIUM SP., ON BAMBUSA SP.

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Cerebella andropogonis Ces., on *Tricholaena repens*

In 1941, R. F. Langdon published his paper on "The Genus Cerebella Cesati - its Biologic Status and Use."

The genus *Cerebella* was described by Cesati in 1851 from material collected on *Bothriochloa ischaemum* in northern Italy, and was for many years regarded as a true smut, closely allied to *Thecaphora* or *Urocystis*. It is now recognized as a saprophyte of ergot honey-dew and can be an indicator of the presence of *Claviceps purpurea* Tul. This would suggest the necessity of carefully examining imported grass seeds for *Claviceps* spp. when *Cerebella* is seen, so as to prevent the importation of new species of the grass parasite.

Phytopathology V.32, No. 7, pp. 613-617. 1942.

Chaetomium sp., on *Bambusa* sp.

Perithecia superficial, free or admate, generally seated on a superficial mycelium and with a distinct ostiolum and an apical tuft of hair or bristles, brown, thin-membranaceous. Asci club-shaped or cylindrical, very evanescent without paraphyses. Ascospores 1-celled and brown, more or less compressed or flattened.

(The *Chaetomium* spp. are usually found on dead or decayed wood.)

The North American Pyrenomycetes, by J. B. Ellis & B. M. Everhart. p. 122.

COLLETOTRICHUM GLOEOSPORIOIDES PENZ. = THE CONIDIAL STAGE OF GLOMERELLA CINGULATA (STON.) SPAULD. & SCHRENK (BITTER ROT OF APPLES), ON MALUS SYLVESTRIS

INFECTION IN APPLE BEGINS WHEN GERMINATING CONIDIA SEND GERM TUBES THROUGH THE SKIN, USUALLY THROUGH WOUNDS, OCCASIONALLY THROUGH A SOUND SURFACE. THE MYCELIUM GROWS SUB-EPIDERMALLY, BRANCHING RAPIDLY, INTERCELLULARLY AND INTRACELLULARLY, ABSORBING THE SUGAR AND OTHER NUTRIENTS PRESENT, AND RESULTING IN BROWN DISCOLORATION OF CELLS AND DISSOLUTION OF THEIR CONNECTION WITH NEIGHBORING CELLS. THE MYCELIUM IS FIRST HYALINE BUT LATER, ESPECIALLY IN THE STROMATA, IT MAY BE QUITE DARK. ACERVULI SOON APPEAR, OFTEN IN CONCENTRIC RINGS, LIFTING THE EPIDERMIS WITH THEIR PALISADES OF CONIDIOPHORES. THE LATTER, AT FIRST HYALINE, LATER OLIVACEOUS, BEAR THE NUMEROUS CONIDIA, WHICH ARE PINKISH, RARELY CREAM-COLORED, IN MASS. CONIDIA HYALINE TO GREENISH, CHIEFLY OBLONG, UNICELLULAR 3.5-7 X 10-28 MU. IN GERMINATION THE CONIDIA BECOME UNISEPTATE AND OFTEN ON THE TIPS OF THE YOUNG MYCELIUM DEVELOP THE DARK THICK-WALLED IRREGULAR SHAPED SPORE-LIKE STRUCTURES, SO COMMON ON THE SPORELINGS OF THE MELANCONIALES, WHICH SERVE AS ORGANS OF ATTACHMENT TO AID IN INFECTION.

PERITHECIA ON DECAYING FRUITS, SUBSPHERICAL, MORE OR LESS GROUPED; ASCI SUBCLAVATE, FUGACEOUS, 55-70 MU; ASCOSPORES ALLANTOID, 3-5 X 12-22 MU.

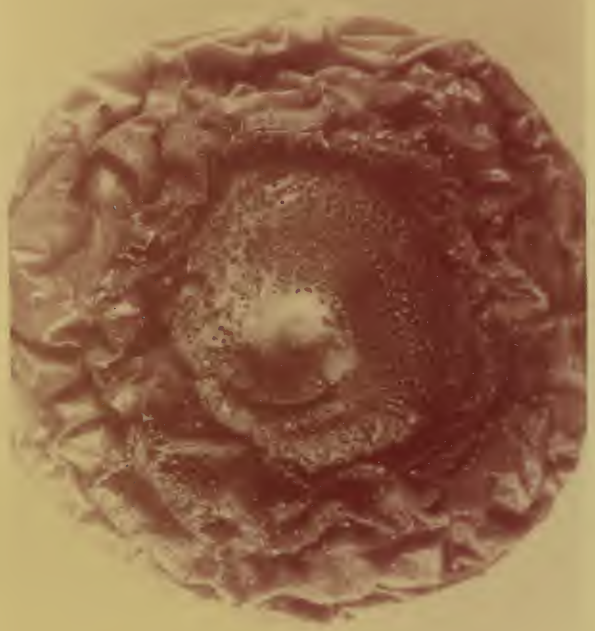
IN CANKER FORMATION THE MYCELIUM GROWS IN THE LIVE BARK, KILLING IT AND THE CAMBIUM. THE CANKERS ARE THOUGHT TO BE COMPARATIVELY SHORT LIVED, PERHAPS SURVIVING ONLY THE THIRD YEAR. RECIPROCAL INOCULATIONS BETWEEN FRUIT AND TWIGS HAVE PROVED THE FUNGUS IN THE TWO CASES TO BE IDENTICAL. CONIDIA AND ASCOSPORES DEVELOP ON BOTH FRUIT AND TWIGS. THE MYCELIUM HIBERNATES IN LIMB CANKERS AND IN MUMMIFIED FRUIT.

THE FUNGUS COLLETOTRICHUM GLOEOSPORIOIDES HAS BEEN DESCRIBED BY VARIOUS AUTHORS AND AT VARIOUS TIMES UNDER NUMEROUS OTHER SPECIFIC NAMES IN THE GENERA COLLETOTRICHUM AND GLOEOSPORIUM, DEPENDING LARGELY ON THE HOST INVOLVED.

PLANT DISEASE FUNGI, BY F. L. STEVENS. PP. 190-192. 1925.

COLLETOTRICHUM GLOEOSPORIOIDES PENZ. CONIDIAL STAGE OF GLOMERELLA CINGULATA (STON.) SPAULD. & SCHRENK, ON MALUS SYLVESTRIS

45



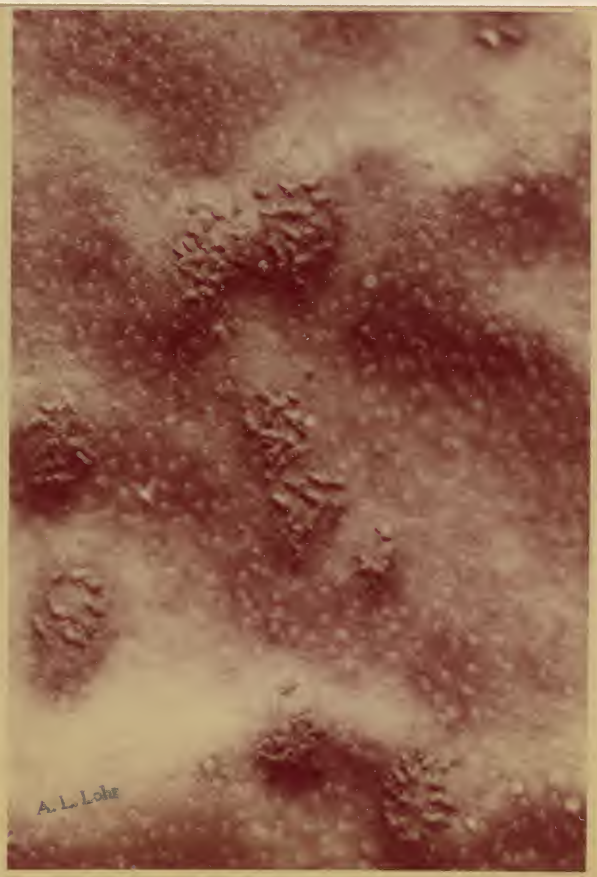
A. L. Lohr

COLLETOTRICHUM GLOEOSPORIOIDES PENZ., SHOWING AN ENLARGED SECTION ON MALUS SYLVESTRIS

46

CRONARTIUM COLEOSPORIOIDES (D. & H.) ARTH., ON PINUS CONTORTA

47



AULOGRAPHUM SP., ON AGAVE SP. LEAF

48

CRONARTIUM COLEOSPORIOIDES (D. & H.) ARTH., ON PINUS CONTORTA

PYCNIA CAULICOLOUS, SCATTERED IRREGULARLY OVER LARGE AREAS, FORMING MINUTE BLISTER-LIKE SWELLINGS. AECIA CAULICOLOUS, SCATTERED OVER LARGE AREAS, CAUSING NO SWELLING OF THE HOST, THE PERIDIA CYLINDRIC, WITH FILAMENT-LIKE STRANDS EXTENDING LENGTHWISE THROUGH THE SPORE-MASS (PERIDERMIUM FILAMENTOSUM), OR CAUSING MODERATE SWELLING, THE PERIDIA FLATTENED, WITH STRANDS EXTENDING PART WAY INTO THE SPORE-MASS FROM ABOVE AND BELOW (PERIDERMIUM STALACTIFORME), AS ILLUSTRATED, CAUSING LARGE, ROUND OR ANNULAR SWELLINGS, THE PERIDIA FLATTENED, WITH VERY SHORT OR NO STRANDS (PERIDERMIUM HARKNESSII); AECIOSPORES OBLONG, OBOVATE-OBLONG, OR ELLIPSOID, 14-24 X 23-35 MU; WALL COLORLESS, 2.5-4 MU THICK, COARSELY VERRUCOSE, SOME SPORES SHOWING A SMOOTH AREA ON ONE SIDE TOWARD THE BASE.

UREDIA AND TELIA ON THE GENERA CASTILLEJA SPP., ORTHOCARPUS LUTEUS, PEDICULARIS SPP., AND CORDYLANTHUS SPP.

MANUAL OF THE RUSTS IN UNITED STATES AND CANADA, BY J. C. ARTHUR. P. 29. 1934.

AULOGRAPHUM SP., ON AGAVE SP. (LEAF)

PERITHECIA MINUTE, SLIGHTLY LINEAR, SIMPLE TO BRANCHED, OPENING WITH A VERY NARROW CLEFT. MEMBRANACEOUS. ASCI SHORT, TYPICALLY 8-SPORED AND WITHOUT PARAPHYSES. SPORES OVATE-OBLONG, 1-SEPTATE, HYALINE, RARELY (IMMATURE?) CONTINUOUS.

SACCARDO 2:727. 1883.

MELANOMMA PULVIS-PYRIUS (PERS.) FCKL., ON DEAD RHODODENDRON STEM

PERITHECIA GENERALLY CROWDED, OFTEN FORMING A CONTINUOUS LAYER OF CONSIDERABLE EXTENT, BUT SOMETIMES SCATTERED, SUPERFICIAL, IRREGULARLY SPHERICAL OR OVATE, WRINKLED OR OTHERWISE ROUGHENED, EITHER SULCATE OR SMOOTH ABOVE, HARD, BLACK, 400 MU IN DIAMETER, WITH A SMALL PAPILLIFORM OSTIOLUM. ASCI CYLINDRICAL OR SUB-CLAVATE, STIPITATE, 8-SPORED, 6-9 X 80-100 MU, WITH FILIFORM PARAPHYSES. ASCO-SPORES UNISERIATE, OBLONG, NARROWED TOWARDS EACH END, ROUNDED ABOVE, STRAIGHT OR A LITTLE CURVED, 3-SEPTATE, AND SLIGHTLY CONSTRICTED AT THE SEPTA, BROWNISH, 4-6 X 16-18 MU.

ON DEAD LIMBS AND WOOD.

THE NORTH AMERICAN PYRENOMYCETES, BY J. B. ELLIS & B. M. EVERHART. P. 181. 1892.

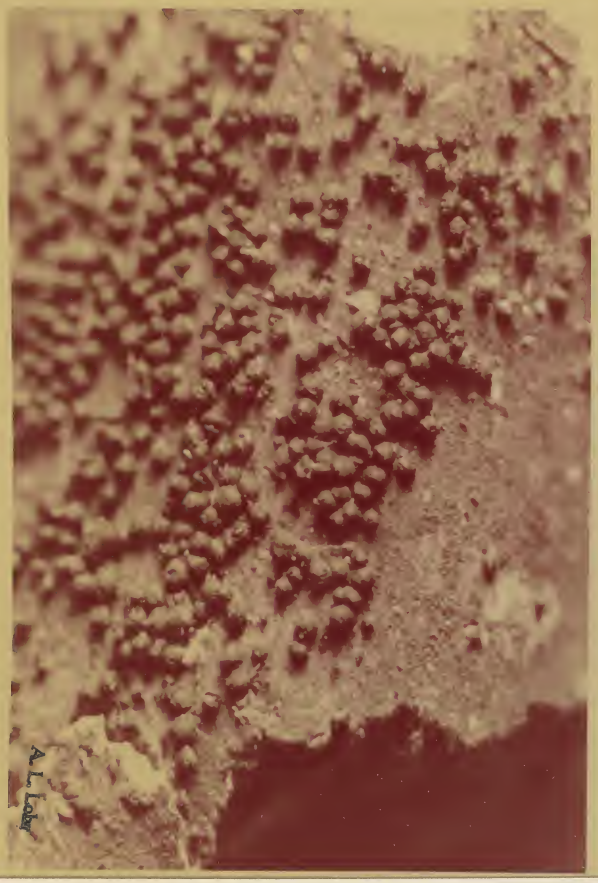
SCLEROTINIA KERNERI WETTST., ON ABIES BALSAMEA

AS SHOWN BY THE PHOTOGRAPH, THE SCLEROTIA OF THIS FUNGUS OCCUR BETWEEN THE SCALES OF DEAD MALE CATKINS (STAMINATE CONES). APOTHECIA DEVELOPING IN CLUSTERS FROM THE SCLEROTIUM, AND USUALLY ERUMPENT AT ITS EDGES, CAMPANULATE-GLOBOSE, NARROWED BELOW TO A SMOOTH SHORT STALK, PALE BROWNISH, RARELY SESSILE, APOTHECIAL OPENING AT FIRST SMALL, THEN ENLARGED, BUT ALWAYS CONTRACTED, MARGIN FINELY PULVERULENT BUT OF THE SAME COLOR, HYMENIUM CONCAVE, DARK, 1 - 4 MM. IN DIAMETER, STALK 1 - 1.5 MM. LONG; ASCI CYLINDRICAL ABOUT 9-12 X 100 MU, EIGHT-SPORED, SPORE BEARING FOR NEARLY THE WHOLE LENGTH; SPORES OBLIQUELY TO VERTICALLY MONOSTICHOUS; HYALINE ELLIPSOIDAL, RARELY ELONGATE-ELLIPSOID, WALL THICK, 12-18 X 20-26 MU; PARAPHYSES FILIFORM, SIMPLE, CLAVATELY THICKENED AND SLIGHTLY WARTY ABOVE, DARK-BROWN, 100 MU LONG, AT THE TIP 3 - 4 MU THICK.

SACCARDO'S SYLLOGE FUNGORUM 8:197. 1889.

MELANOMMA PULVIS-PYRIUS (PERS.) FCKL., ON DEAD RHODODENDRON STEM

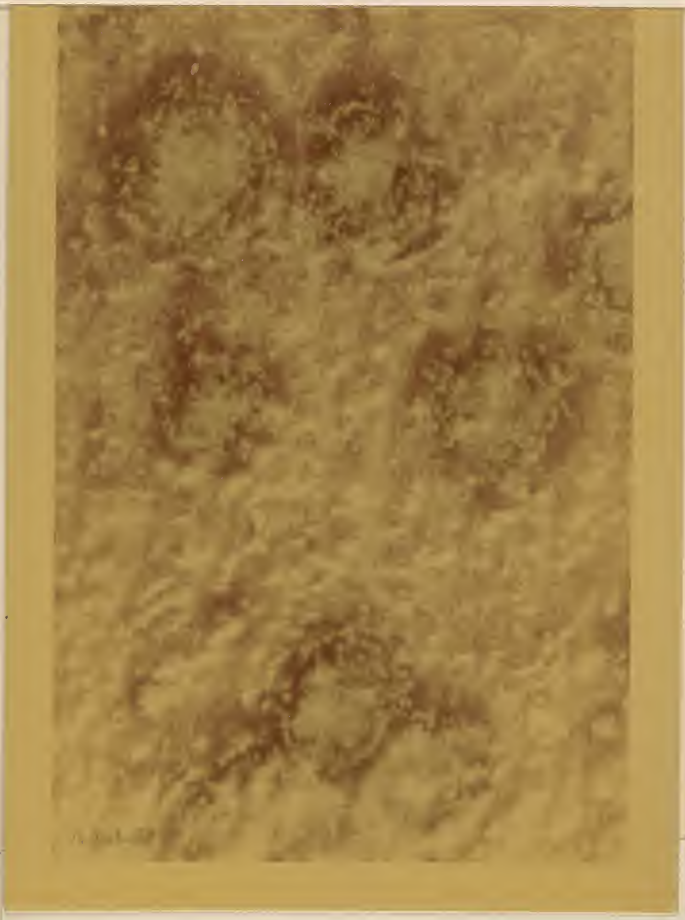
49



SCLEROTINIA KERNERI WETTST., ON ABIES BALSAMEA

50

EXOBASIDIUM VACCINII (FCKL.) WOR., ON RHODODENDRON NUDIFLORUM (AZALEA) 51



SPHACELOMA PUNICAE BITANC. & JENKINS ON PUNICA GRANATUM (POMEGRANATE) 52

Exobasidium vaccinii (Fckl.) Wor., on *Rhododendron nudiflorum* (Azalea)

Exobasidium vaccinii occurs on a wide range of ericaceous hosts including Vaccinium, Andromeda, Rhododendron, forming large blisters on the leaves, rarely on petioles and stems, discoloration red or purple. The fungus appears as a white bloom on the under surface of the leaf; spores narrowly fusiform, 1-1.5 X 6-9 mu. Basidia 2 or 4 spored.

This genus is strictly parasitic, the mycelium penetrating the host and usually causing marked hypertrophy and hyperplasia, producing leaf-galls and shoot-galls and bud-galls. The galls are composed principally of the tissues of the hosts with hyphae between the cells. The form of the gall is dependent on: (1) the organ affected, (2) the degree of resistance, and (3) the age of the organ. Hymenium unaccompanied by fleshy sporocarp, consisting only of the closely-crowded, clavate basidia which break through the epidermis of the host.

The basidia bear two to four sterigmata and spores. The spores are mostly curved. Conidia are also found in some species. The basidiospores germinate with a germ tube which produces fine sterigmata and secondary spores capable of budding. The hymenial cells are binucleate, the two nuclei of the basidial cell fusing into one basidium-nucleus. This divides mitotically giving rise to the spore nuclei.

This genus among the basidia fungi is analogous to *Taphrina* among the ascus fungi.

Plant Disease Fungi, by F. L. Stevens. pp. 287-288. 1925.

Sphaceloma punicae Bitanc. & Jenkins (*Hadrotrichum populi* Montem. not Sacc.), on *Punica granatum* (Pomegranate)

This organism causes a foliar anthracnose of pomegranate and a fruit spot on the same host. The hyaline to pale yellowish stroma, 15-40 mu in thickness, gives rise to a dense palisade of closely appressed conidiophores 3-5 X 10-15 mu; macroconidia did not develop, but microconidia were abundant on the surface of the acervuli.

New Discoveries of Myriangiales in the Americas, by A. A. Bitancourt and A. E. Jenkins - Proceedings - Eighth American Scientific Congress - Biological Sciences: Botany, p. 163. 1940.

CERCOSPORA CAPSICI HEALD & WOLF, ON CAPSICUM ANNUUM

ALTHOUGH CERCOSPORA LEAF SPOT OCCURS WHEREVER PEPPERS ARE GROWN COMMERCIALLY, IT IS SELDOM OF MUCH ECONOMIC IMPORTANCE UNLESS THE SEASON IS EXCESSIVELY WET.

SMALL, WATER-SOAKED SPOTS, WHICH LATER TURN PAPERY AND WHITE WITH SLIGHTLY BROWNISH MARGINS, ARE PRODUCED ON THE LEAVES. SEVERE INFECTION CAUSES YELLOWING AND DROPPING OF THE FOLIAGE. THE FRUIT STEMS ARE SOMETIMES ATTACKED AND FREQUENTLY THE PATHOGEN WORKS DOWN THROUGH THEM CAUSING A STEM-END DECAY OF THE POD.

CONIDIA MEASURE 2.5-4 X 30-200 MU; CONIDIOPHORES 3.5-5 X 20-150 MU.

U.S.D.A. MISC. PUBLICATION NO. 121, 1932. P. 33.

MACROPHOMA SP., ON ORCHID (LEAF)

THE UPPER AND LOWER SURFACES OF THE ORCHID LEAF ARE SHOWN IN THE PHOTOGRAPH. WHILE THE ILLUSTRATED SYMPTOMS RESEMBLE COLLETOTRICHUM GLOEOSPORIORIDES, MACROPHOMA CONIDIA WERE FOUND ON THE SPECIMEN. THAT GENUS IS OF COURSE A FORM GENUS, PRODUCING SPORES IN A PYCNIDIUM IN THE SAME MANNER AS PHOMA. HOWEVER, THE SINGLE-CELLED, HYALINE CONIDIA OF THIS GENUS ARE EXPECTED TO EXCEED 15 MU IN LENGTH IF THE FUNGUS IS TO BE DESIGNATED AS MACROPHOMA. SPORES OF PHOMA ARE LESS THAN 15 MU.

CERCOSPORA CAPSICI HEALD & WOLF, ON CAPSICUM ANNUUM

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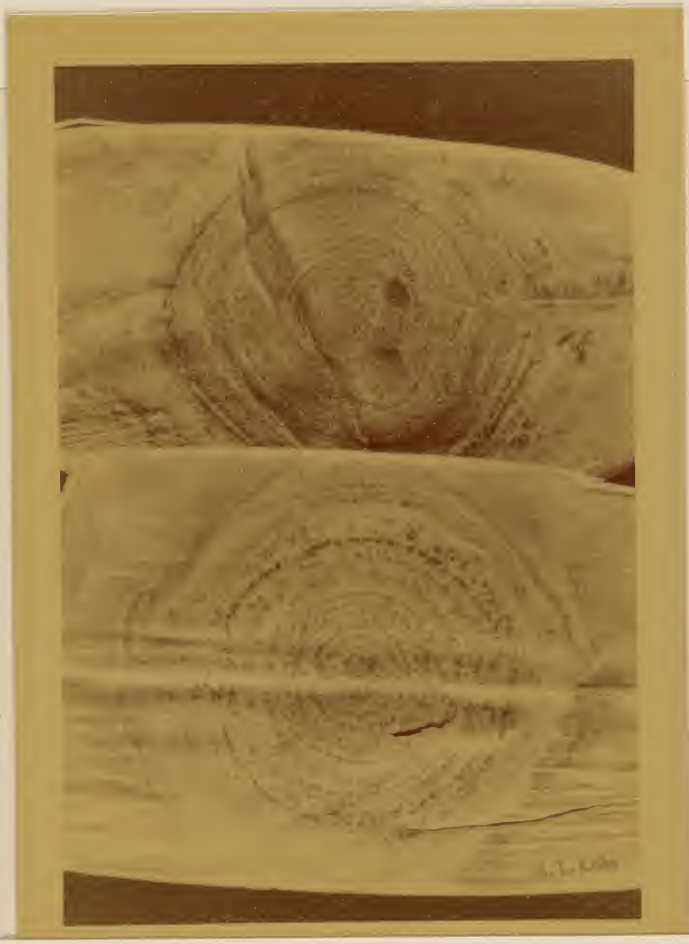
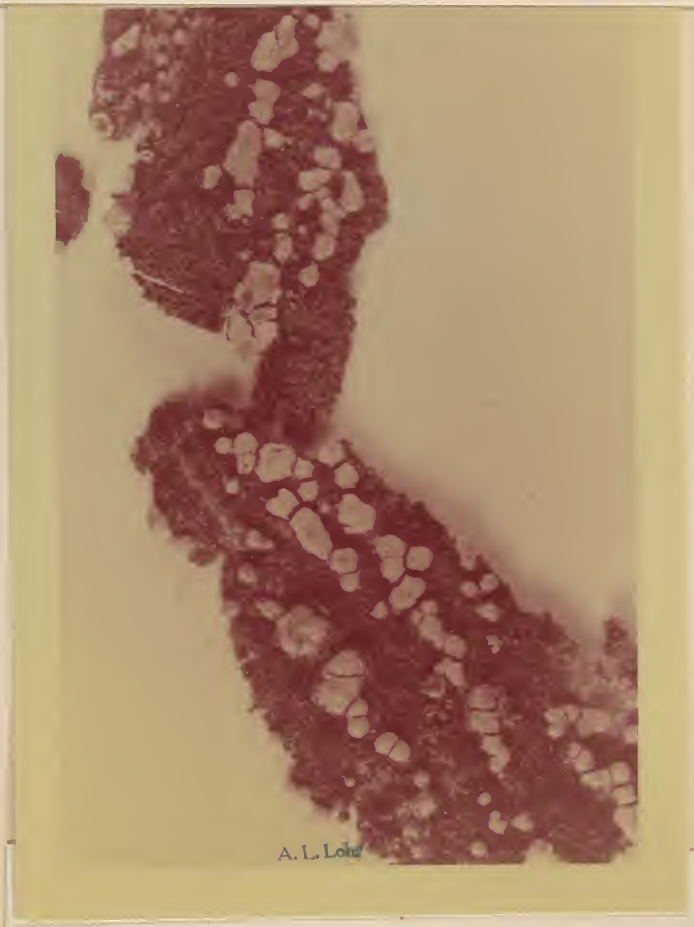
MACROPHOMA SP., ON ORCHID LEAF SHOWING TOP AND UNDERSIDE OF LEAF.

54



SPHACELOTHECA SORGHI (LK.) CLINT. (SMUT) ON SORGHUM VULGARE 55



NECTRIA CINNABARINA TODE EX FR. AND ITS IMPERFECT STAGE TUBERCULARIA VULGARIS TODE EX FR. ON ACER MACROPHYLLUM 56

Sphacelotheca sorghi (Lk.) Clint., on Sorghum vulgare (kernel smut)

Sori usually in the ovaries or stamens forming oblong to ovate bodies 3–12 mm. in length, rarely fusing the very young spikelets into irregular forms, protected for some time by a false membrane upon the rupture of which the olive-brown spore-mass becomes scattered, leaving naked the distinct columella of plant tissue. The sterile cells of the membrane break up to some extent into groups, hyaline, oblong to subspherical, chiefly 7–18 mu in length; spores subspherical to spherical, smooth, contents often granular, 5.5–8.5 mu in diameter.

When smutted seed is planted, the spores germinate along with the seed. The growing fungus then invades the developing seedling and continues to grow undetected inside the plant until after heading, when the smut galls, which have formed in place of the kernels, become evident. Plants affected by covered kernel smut appear normal except for the smutted heads. This smut can be effectively controlled by proper seed treatment.

Smutted seed shown to the left in the photograph.

Plant Disease Fungi, by F. L. Stevens. pp. 220–221.
Plant Diseases - The Yearbook of Agriculture. p. 373. 1953.

Nectria cinnabarina (Tode) Fr. and its imperfect stage Tubercularia vulgaris (Tode) Fr., on Acer macrophyllum

Stroma erumpent, tubercular, at first pinkish or yellow-red, darker with age, 1–2 mm. high and broad; perithecia almost globose, the ostiole rather prominent, becoming slightly collapsed, at first bright cinnabar-red, darker with age, granular, 375–400 mu in diameter; asci clavate, 7–12 X 50–90 mu; spores mostly 2-seriate, elliptic elongate, ends obtuse, slightly curved, 4–6 X 12–20 mu; paraphyses delicate.

Tubercularia vulgaris, borne on the stroma, is the conidial stage. Conidiophores aggregated into tubercular masses each 50–100 mu long; conidia on short lateral branches, elliptic, hyaline, 2 X 4–6 mu, no chlamydospores.

The closely septate delicate hyphae grow rapidly through the wood or bark, penetrating nearly every cell, turning the wood black and collecting to form stromata on or in the bark. These stromata in fall or spring break through the epidermis and produce warty, gray to pink, excrescences, which at first bear profuse conidia both terminally and laterally on short stalks. Later dark-red ascigerous structures arise though they are much less common. The fungus is said to be unable to affect living cambium and cortex.

It is found saprophytically on many decayed woody plants that have been frost killed, and is weakly parasitic on pear, currant, linden, horse chestnut, Chinaberry, birch, elm, Carya, Prunus, maple, mulberry, oak, etc.

Plant Disease Fungi, by F. L. Stevens. p. 148. 1925.

BACTERIAL GALLS ON RHODODENDRON "LETTY EDWARDS", CAUSED BY SOME OTHER ORGANISM THAN THE CROWN GALL BACTERIUM, AGROBACTERIUM TUMEFACIENS SM. & TOWN.

MACROPHOMINA PHASEOLINA (TASSI) GOID., IN MICROSCLEROTIAL STAGE ON IPOMEA BATATAS TUBER. FOR A DESCRIPTION SEE M. PHASEOLINA ON GLADIOLUS.

GALLS (BACTERIAL) BUT NOT CROWN GALL OF AGROBACTERIUM TUMEFACIENS SM. & TOWN., ON RHODODENDRON LETTY EDWARDS. 57

MACROPHOMINA PHASEOLINA (TASSI) GOID., IN MICROSCLEROTIAL STAGE ON IPOMOEA BATATAS TUBER. 58

MARMOR LINEOPICTUM CATION, (LINE PATTERN VIROSIS) ON PRUNUS KAZAN SPLENDENS. 59

LINE PATTERN VIRUS ON HUMULUS LUPULUS (HOP) 60

MARMOR LINEOPICTUM CATION, ON PRUNUS KAZAN SPLENDENS

COMMON NAMES: PRUNUS LINE-PATTERN VIRUS, PEACH LINE-PATTERN VIRUS

THE SYMPTOMS ARE ALMOST INVARIABLY CONFINED TO THE LEAVES EMERGING IN THE SPRING WHEN THE DAILY MEAN TEMPERATURES ARE BELOW 55^{0} TO 60^{0} F., AND THEY PERSIST ON THESE LEAVES THROUGHOUT THE SEASON. LATER IN THE SUMMER MOST OF THE LEAVES PRODUCED ON INFECTED TREES ARE SYMPTOMLESS.

LINE PATTERN ON MOST VARIETIES OF PLUM AND PEACH APPEARS TO BE OF NEGLIGIBLE IMPORTANCE. ON ORIENTAL FLOWERING CHERRY SYMPTOMS ARE COMPOSED OF PATTERNS OF LARGE RINGS, OR MORE OFTEN THEY ARE OF THE OAK-LEAF TYPE. IN EITHER CASE THE DAMAGE IS APPARENTLY LIMITED TO UNSIGHTLY FOLIAGE.

THERE ARE INDICATIONS, HOWEVER, THAT THE SEVERITY OF INJURY IS INCREASED WHEN THE LINE-PATTERN VIRUS IS COMBINED WITH OTHER VIRUSES AND A COMPLEX INFECTION RESULTS.

TRANSMISSION IS EASILY EFFECTED BY BUDDING AND BARK-PATCH GRAFTING. OBSERVATIONS INDICATE THAT THE VECTOR IS COMPARATIVELY RARE AND THE DISPERSION RANGE IS SHORT.

AGRICULTURAL HANDBOOK NO. 10, VIRUS DISEASES AND OTHER DISORDERS OF STONE FRUITS IN NORTH AMERICA, BY DONALD CATION, G. H. BERKELEY, J. A. MILBRATH, P. S. WILLISON AND S. M. ZELLER. P. 177. 1951.

LINE-PATTERN VIRUS, ON HUMULUS LUPULUS (HOP)

THE COMMON NAME, LINE-PATTERN VIRUS, WAS USED BY DR. PHILIP BRIERLEY AS A TEMPORARY NAME UNTIL SOME DEFINITE INFORMATION IS AVAILABLE ON THIS APPARENT VIRUS CONDITION OF HOPS.

UPON CONSULTING THIS DEPARTMENT'S VIRUS DISEASE SPECIALISTS WE FOUND THAT NO WORK HAD BEEN COMPLETED ON THIS HOP DISEASE. FOR THAT REASON THE PHOTOGRAPH WILL HAVE TO SERVE OUR PURPOSE.

MOTTLED DISTORTION ON *PRUNUS* SP. (CHERRY), APPARENTLY A GENETIC CONDITION

ACCORDING TO SPECIALISTS WORKING WITH STONE FRUIT VIRUSES THIS IS AN EXAMPLE OF A CONDITION SUGGESTING A VIRUS INFECTION. HOWEVER, IT HAS NOT BEEN SHOWN TO BE TRANSMISSIBLE AND IS THEREFORE BELIEVED TO REPRESENT A GENETIC CONDITION.

CAMELLIA RING SPOT VIRUS?, ON CAMELLIA LEAF

NO WORK OF SIGNIFICANCE HAS BEEN DONE ON THIS CONDITION OF CAMELLIA WHICH HAS BEEN REFERRED TO BY THE NAME SHOWN ABOVE. THERE SEEMS TO BE SOME QUESTION AS TO WHETHER THIS AND THE "YELLOW-SPOT VIRUS" OF MILBRATH AND MCWHORTER ARE THE SAME DISEASE. THE RING-SPOT CONDITION HAS BEEN LISTED IN ALL THE SOUTHERN STATES WHERE CAMELLIAS ARE GROWN AND IT HAS LIKEWISE BEEN SEEN IN CALIFORNIA.

MOTTLED DISTORTION ON
PRUNUS SP. (CHERRY) APPARENTLY
GENETIC CONDITION

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CAMELLIA RING SPOT PRESUMABLY OF VIRUS ORIGIN,
ON CAMELLIA SP. LEAF

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CERCOSPORA HANDELII BUB. ON RHODODENDRON (AZALEA) SP. 63

SYNCHYTRIUM ENDOBIOTICUM (SCHILB.) PERS. ON SOLANUM TUBEROSUM. 64

Cercospora handelii Bub., on Rhododendron (Azalea) sp.

Leaf spots circular to irregular, 2-10 mm. in diameter, pale brown or almost gray to dark reddish brown, orange to black line margin, occasionally slightly zonate, dull brown on the lower leaf surface; fruiting amphigenous, but chiefly epiphyllous, often accompanied by an immature perithecial stage showing clearly on the lower leaf surface; stromata dark brown to almost black, variable in shape and size, 15-70 mu in diameter; fascicles dense, compact; conidiophores delicate, curved or undulate, subhyaline to pale olivaceous, in mass medium dark brown, septation indistinct or lacking, not branched, sparingly geniculate, rounded tip somewhat attenuated, 2-4 X 15-70 mu; conidia subhyaline to very pale olivaceous, narrowly linear to almost distinctly obclavate, straight to mildly curved or undulate, indistinctly multiseptate, base obconic to truncate, tip subacute, 1.5-3 X 20-140 mu.

A Monograph of the Fungus Genus Cercospora, by Charles Chupp. pp. 207-208. 1953.

Synchytrium endobioticum (Schilb.) Pers., on Solanum tuberosum

In structure S. endobioticum is a very simple fungus, without mycelium. The first infections in the spring are produced by oval shaped one-ciliate zoospores about 2 mu in length which are formed when the resting spores or sporangia germinate. These first infections develop as sori, each of which divides to form about five summer sporangia. Within a few days after infection takes place there may be an abnormal enlargement and multiplication of host cells to form a tumor or in highly resistant varieties there may be little enlargement of the host tissue. The summer sporangia germinate by the production of 200-300 oval shaped one-ciliate zoospores about 1.5 mu long. If these zoospores have been mature for two or three days before there is sufficient moisture to cause their release, many of them may act as gametes, those from different sporangia uniting in pairs to form zygotes. If the zoospores cause new infections, such infections develop as sori and produce summer sporangia, but infections produced by zygotes form resting sporangia. Resting sporangia become dark brown, thick walled, more or less globular and 50-70 mu in diameter. These may remain viable for some time but usually germinate as soon after maturity as water is available whether that is within an hour or two or is delayed a week or more. Zoospores from resting spores may begin to disintegrate within a couple of hours or so after the sporangia rupture if they are unable to infect a host and those from summer sporangia in less than an hour. Either zoospores or zygotes may infect wart tissue as well as normal host tissue. The enormous number of sporangia, particularly of resting sporangia, that may be produced during a season, and the ability of the resting sporangia to remain viable for years enable the fungus to survive ordinary crop rotations and cause heavy damage.

F.P.Q. In-Service Training Series No. 6, by N. Rex Hunt. 1940.

INTUMESCENCES ON LEAVES OF *VITIS* SP.

THIS CONDITION OF CELL ENLARGEMENT IS USUALLY CONFINED TO THE GREENHOUSE, AND IS CAUSED BY AN EXCESS OF WATER, LACK OF LIGHT, AND IMPROPER TEMPERATURE. IT IS READILY CONTROLLED BY CAREFUL GREENHOUSE MANAGEMENT THAT ELIMINATES THE MENTIONED CAUSES.

MANUAL OF PLANT DISEASES, BY DR. F. D. HEALD. P. 101. 1933.

ASCHERSONIA SP., PARASITIZING SCALE INSECT, ON PALM LEAF

ASCHERSONIA IS LISTED AS ONE OF THE BENEFICIAL FUNGI BECAUSE OF THE ROLE IT PLAYS IN HELPING TO KEEP INSECT PESTS IN CHECK.

APPARENTLY NO DESCRIPTION OF THIS PARTICULAR SPECIES HAS BEEN PUBLISHED.

INTUMESCENCES ON LEAVES
OF VITIS SP.

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ASCHERSONIA SP. PARASITIZING SCALE INSECT
ON PALM LEAF.

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RASP LEAF (VIRUS) ON
PRUNUS SP. (CHERRY)

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DIPLODIA NERII SPEG. ON NERIUM OLEANDER
SHOWING CROSS SECTION AND LONGITUDINAL
SECTION OF PYCNIDIA.

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Rasp Leaf (Virus), on *Prunus* sp. (Cherry)

The most characteristic symptom of rasp leaf is the production of abnormal outgrowths on the lower surface of the leaves. These outgrowths vary from elongated protuberances to dark green leaflike growths. On a given leaf the growths usually occur between the veins and radiate from the midrib toward the margin of the leaf blade. On the upper surface of a diseased leaf there are depressed, roughened areas lighter in color than the normal green of the leaf. Since the majority of the growths on the lower surface of affected leaves resemble the teeth of a course rasp, the name "rasp leaf" was given to the disease. Severely affected leaves are small, narrow, and markedly distorted. The leaf blade frequently has a tendency to fold in upon itself. Trees may be completely or partially affected; it is not uncommon to find an uneven expression of symptoms on a branch or a tree. Damage to diseased trees consists of retardation in growth and the consequent reduction in the size of the crop.

Transmission has been effected only through graft and bud inoculations.

(See *Marmor lineopictum* for reference.)

Diplodia nerii Speg., on *Nerium oleander*

Pycnidia lenticular (lens-shaped), subepidermal, at length erumpent, black, 200-250 mu in diameter, spores ovoid to elliptical, 1-septate, constricted, dark-olivaceous, 8-10 X 18-22 mu.

The illustration shows the gregarious habit of the pycnidia, both in cross and longitudinal section. This fungus, originally described from twigs and petioles of oleander in northern Italy (1884), is also reported from California.

Saccardo 3:347. 1884.

DIATRACTIUM CORDIAE (F. L. STEVENS) SYD., ON CORDIA GLABRA

SYN.: TRABUTIELLA CORDIAE STEVENS

SPOTS WHEN YOUNG ARE SLIGHTLY DISCOLORED; LATER THE TISSUE DIES AND THE SPOTS MAY FADE TO ALMOST WHITE. SPOTS DEFINITELY BORDERED, ALMOST EXACTLY CIRCULAR, 5 - 10 MM. IN DIAMETER, WITH THE PERITHECIA IN QUITE REGULAR CONCENTRIC RINGS. THE BLACK CLYPEUS ALWAYS EPIPHYLLOUS, ABOUT 280 MU IN DIAMETER, OR OBLONG AND 240 X 500 MU. OSTIOLE 45-75 MU IN DIAMETER. PERITHECIA NOT VISIBLE FROM BELOW, LOCATED IN THE MESOPHYLL, 260-360 MU IN DIAMETER. ASCI 17 X 85 MU, 16-SPORED, THIN-WALLED; SPORES OBLONG, POINTED AT EACH END, 3.5 X 20 MU, CONTINUOUS, HYALINE.

STEVENS ORIGINALLY DESCRIBED THIS FUNGUS ON CORDIA COLLOCOCCA.

NEW OR NOTEWORTHY PORTO RICAN FUNGI, BY F. L. STEVENS. THE BOTANICAL GAZETTE, V.70, P. 401, JULY - DECEMBER 1920.

DIATRACTIUM CORDIAE (F. L. STEVENS) SYD. ON CORDIA GLABRA

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DIATRACTIUM CORDIAE (F. L. STEVENS) SYD. ON CORDIA GLABRA, SHOWING AN ENLARGED SECTION OF THE LEAF.

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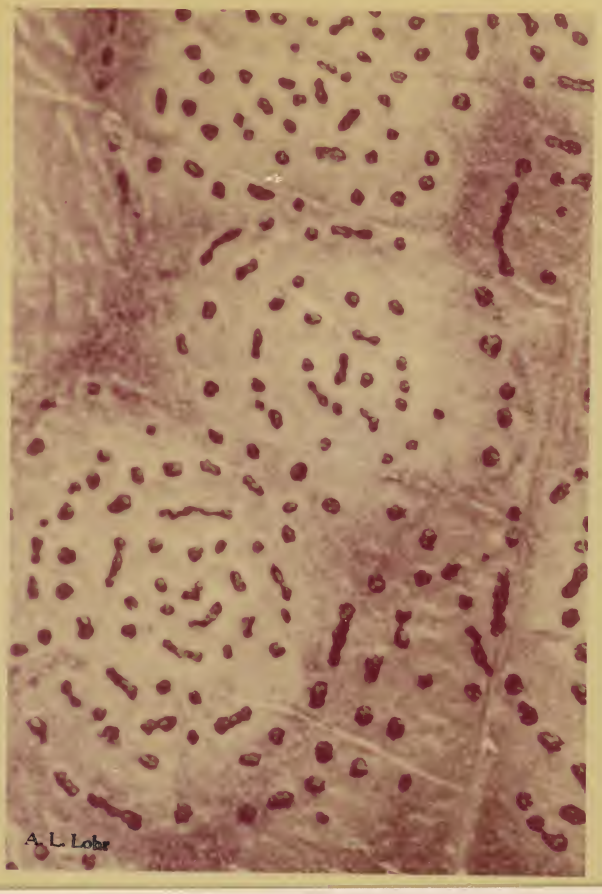

USTILAGO MAYDIS (DC.) CDA. ON ZEA MAYS.

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UREDO SCABIES CKE. ON VANILLA PLANIFOLIA

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USTILAGO MAYDIS (DC.) CDA. [USTILAGO ZEAE (BECKM.) UNG.], ON ZEA MAYS

THIS DISEASE APPEARS ON THE VARIOUS AERIAL PARTS OF THE CORN PLANT AS EITHER SMALL OR LARGE TUMORS, AT FIRST WHITISH DUE TO A COVERING MEMBRANE, BUT LATER DARK AND THEN BLACK FROM THE DEVELOPMENT OF THE ENCLOSED SMUT MASS. THESE SMUT TUMORS OR SORI MAY VARY IN SIZE FROM MINUTE PUSTULES ON THE LEAVES TO OTHERS, ON THE STALKS OR EARS, AS LARGE AS A CHILD'S HEAD. WHEN THEY REACH MATURITY THE COVERING MEMBRANE DRIES AND BREAKS, EXPOSING THE DRY, POWDERY MASS OF SPORES.

THIS ORGANISM IS ONE OF THE TRUE SMUTS, OR USTILAGINALES, IN WHICH THE INFECTIONS ARE LOCALIZED AT THE POINT OF INFECTION AND ARE NOT THE RESULT OF A MYCELIUM THAT HAS GROWN UP THROUGH THE TISSUES OF THE PLANT FROM THE SEEDLING STAGE AS IN SPHACELOTHECA SORGHI (SEE ILLUSTRATION).

THE MATURE SPORES ARE SPHERICAL TO ELLIPSOID, 7-12 MU IN DIAMETER, WITH A BROWN WALL COVERED WITH SMALL SPINES. WHEN GERMINATING, THESE SPORES SEND OUT PROMYCELIA WHICH IN TURN PRODUCE SPORIDIA. THE WINDBORNE SPORIDIA, UPON REACHING IMMATURE PARTS OF THE CORN PLANT, CAUSE INFECTION.

MANUAL OF PLANT DISEASES, BY DR. FREDERICK D. HEALD. PP. 746-749. 1933.

UREDO SCABIES CKE., ON VANILLA PLANIFOLIA

SORI USUALLY HYPOPHYLLOUS, OCCURRING SINGLY, SPOTS SLIGHTLY SWOLLEN, FOR THE MOST PART ORBICULAR (ROUND), 2 - 5 MM. IN DIAMETER, DENSE TO CONCENTRICALLY ARRANGED AND FILLING ONE WHOLE SPOT, OR SINGLY ROUND AND ELLIPTICAL AND 1/2 - 1 MM. IN DIAMETER. CLOSED FOR A LONG TIME, AT LENGTH WITH A CENTRAL OPENING, FINALLY OPENING MORE WIDELY, BROWN; SPORES ELLIPSOID, OVATE TO PIRIFORM, A FEW CONSPICUOUS SPINES, AT FIRST YELLOW, THEN BROWN, 17-26 X 24-36 MU. EPISPORES 2 - 3 MU THICK, PROVIDED WITH 2 EQUATORIAL GERM PORES.

SYDOW, MONOGRAPHIA UREDINEARUM 4:507. 1924.

OVULINIA AZALEAE WEISS, ON RHODODENDRON (AZALEA) SP. (FLOWER)

APOTHECIA ARISING SINGLY OR IN GROUPS OF 2 TO 3 (RARELY UP TO 8) FROM THE MARGIN OF A SCLEROTIUM, LYING ON OR SHALLOWLY COVERED WITH SOIL, IN LATE WINTER AND EARLY SPRING, STIPITATE, URCEOLATE TO CYATHIFORM, FLAT AT MATURITY, 2 - 5 MM. BROAD, TAWNY OLIVE TO SNUFF BROWN, MARGIN SCALY, GRANULOSE OR HIRSUTE; STIPE TYPICALLY 2 - 3 MM. LONG, 1 - 1.5 MM. THICK, ERECT OR SLIGHTLY CURVED, BUT SOMETIMES SINUOUS, FILIFORM, AND UP TO 15 - 18 MM. LONG, CLAY-COLOR AT THE BASE, DARKENING TO CINNAMON AT THE TOP, GLABROUS, RARELY WITH 1 OR A FEW RHIZOIDS, HYMENIAL SURFACE RUSSET TO WALNUT BROWN, SOMEWHAT PRUINOSE. ASCI CYLINDRICAL, 140 - 260 MU (AVERAGE 180 MU) LONG BY 9 - 14 MU (AVERAGE 12 MU) THICK; APICAL PLUG NOT STAINING BLUE WITH IODINE. ASCOSPORES 8, UNISERIATE, ELLIPSOID, 1-CELLED, 8.5-10 X 10-18 MU (AVERAGE 9.3 X 16.3 MU), HYALINE, USUALLY WITH 1 - 2 PROMINENT GLOBULES. PARAPHYSES TERETE, SEPTATE, MOSTLY UNBRANCHED, APICES SLIGHTLY SWOLLEN.

CONIDIA TYPICALLY OBOVOID, HYALINE, 21-36 X 40-60 MU (AVERAGE 28 X 50) INCLUDING THE BASAL APPENDAGE; WHEN FORMED UNDER HIGH HUMIDITY BECOMING CLAVATE TO PYRIFORM, UP TO 72 MU LONG; PRODUCED SINGLY ON SHORT SIMPLE BRANCHES PROTRUDING FROM THE HOST SURFACE AND ARISING FROM A PARASITIC MYCELIUM UNDERNEATH; SEPARATING FROM THE CONIDIOPHORES BY MEANS OF A DISJUNCTOR CELL WHICH REMAINS ATTACHED TO THE CONIDIUM. THIS STAGE FORMS A THIN MAT OR WEFT ON THE SURFACE OF THE HOST ORGAN AND THE CONIDIA ARE PROMPTLY DISSEMINATED THEREFROM BY INSECTS AND METEORIC WATER OR GERMINATE IN PLACE.

SPERMATIA GLOBOSE, 3 - 3.5 MU IN DIAMETER, PRODUCED AT THE TIPS OF FUSOID HYPHAE, 3 X 10-12 MU, WHICH ARE AGGREGATED INTO MINUTE TUFTS (JUST VISIBLE BY A 10X LENS) ON THE HOST SURFACE; USUALLY SEPARATING READILY BUT SOMETIMES ADHERING IN SHORT CHAINS; APPEARING COINCIDENTLY WITH SCLEROTIA.

SCLEROTIA FORMED WITHIN INVADED HOST TISSUES BUT SEPARABLE THEREFROM WHEN MATURE; TYPICALLY OF CIRCULAR TO ELLIPTICAL OUTLINE, OFTEN IRREGULAR, DISTINCTLY CUPPED, SMOOTH ON THE CONCAVE SURFACE, VERRUCOSE TO RUGOSE ON THE CONVEX; 0.5-1.5 X 2-5 X 3-10 MM.; CORTEX AND MEDULLA DIFFERENTIATED STRUCTURALLY BUT AT MATURITY BLACK THROUGHOUT.

OVULINIA SEGREGATED FROM SCLEROTINIA, BY DR. FREEMAN WEISS - PHYTOPATHOLOGY V.30, PP. 243-244. 1940.

ASCHERSONIA TURBINATA BERK., PARASITIZING SCALE INSECT, ON CITRUS SP. (LEAF)

[PERFECT STAGE = HYPOCRELLA TURBINATA (BERK.) PETCH]

IT FORMS PINK PUSTULES ABOUT 1.5 MM. BROAD AND 1 MM. HIGH WITH A TRUNCATE UPPER SURFACE OFTEN CONCAVE. IT IS FOUND ATTACHING THE WAX SCALE, CEROPLASTES.

CITRUS DISEASES AND THEIR CONTROL, BY HOWARD S. FAWCETT. P. 283.

OVULINIA AZALEAE WEISS ON RHODODENDRON (AZALEA) SP. FLOWER. 73

ASCHERSONIA TURBINATA BERK. PARASITIZING SCALE INSECT ON CITRUS SP. LEAF 74

LOPHODERMIUM RHODODENDRI (SCHW.) ELL. & EV. ON RHODODENDRON SP. 75

CURVULARIA LUNATA (WAKK.) BOED. ON BUDS AND STEMS OF GLADIOLUS VARIETY. 76

LOPHODERMIUM RHODODENDRI (SCHW.) ELL. & EV., ON RHODODENDRON SP.

PERITHECIA EPIPHYLLOUS, ON ROUND PALE SPOTS 1 - 2 CM. IN DIAMETER, WITH A REDDISH, SWOLLEN MARGIN BOTH ABOVE AND BELOW, PUNCTIFORM AT FIRST, THEN ORBICULAR, SUBDISCOID, DEPRESSED, 1/2 - 3/4 MM. IN DIAMETER, BECOMING ELLIPTICAL, 3/4 - 1 X 1 - 1-1/2 MM., WITH THE OPPOSITE SIDES SLANTING UP TOWARDS EACH OTHER AND SEPARATED BY A VERY NARROW CLEFT. ASCI CLAVATE, 12-15 X 110-130 MU, 8 SPORED, WITH FILIFORM PARAPHYSES BROADLY RECURVED AT THE TIPS. SPORIDIA LINEAR-CYLINDRICAL, NUCLEATE, CONTINUOUS, HYALINE, 2-2.5 X 60-75 MU.

THE NORTH AMERICAN PYRENOMYCETES, BY J. B. ELLIS AND B. M. EVERHART. P. 717. 1892.

CURVULARIA LUNATA (WAKK.) BOED., ON GLADIOLUS (BUDS AND STEMS)

THIS FUNGUS, ORIGINALLY DESCRIBED FROM SUGARCANE IN JAVA, HAD AT TIMES BEEN RECORDED ON OTHER HOSTS BUT IT HAD NEVER ASSUMED ANY PARTICULAR IMPORTANCE AS A PATHOGEN UNTIL 1948 WHEN IT APPEARED AS A TROUBLESOME PATHOGEN ON THE FLORIDA GLADIOLUS CROP. SINCE THAT TIME IT HAS SPREAD TO VARIOUS OTHER STATES. THE PHOTOGRAPH SHOWS TYPICAL INJURY TO THE FLOWER SPIKES.

THIS ORGANISM IS OF PARTICULAR INTEREST SINCE IT IS ONE THAT SUDDENLY DEVELOPED SERIOUS PATHOGENIC CAPABILITIES. APPARENTLY MUTATION PRODUCED A VIRULENT STRAIN.

SPORES PALE BROWN, 3-SEPTATE, THE THIRD CELL FROM THE BASE LARGER AND DARKER COLORED THAN THE OTHERS, UNEQUALLY VENTRICOSE-FUSIFORM, MORE OR LESS CURVED TO NEARLY STRAIGHT, 9-15.5 X 19.5-32 MU. THE CONIDIOPHORES ARE PALE BROWN, SEPTATE, SIMPLE OR BRANCHED, GENICULATE AT THE TIP, VARIABLE IN LENGTH, 3-5 MU IN DIAMETER.

NOTES ON SEED-BORNE FUNGI III CURVULARIA, BY J. W. GROVES & A. J. SKOLKO - CANADIAN JOURNAL OF RESEARCH V.23, NO. 3, P. 101. 1945.

FUSARIUM OXYSPORUM SCHLECHT. F. NARCISSI SNYDER & HANSEN, ON NARCISSUS BULB

THIS PHOTOGRAPH SHOWS THE TUNNEL MADE BY A LARVA OF THE NARCISSUS BULB FLY, LAMPETIA EQUESTRIS (SEE PHOTOGRAPH), AND THE INFECTION OF BASAL ROT THAT HAS ATTACKED THE DAMAGED BULB TISSUES. THE FIRST EXTERNAL SYMPTOM IS BROWN DISCOLORATION IN THE REGION OF THE BASAL PLATE, WHICH BECOMES SOFT. THE ROT GRADUALLY SPREADS IN THROUGH THE BASAL PLATE AND UP THE INNER SCALES, THE TISSUES OF WHICH BECOME CHOCOLATE-BROWN TO GRAYISH-BROWN IN COLOR, SOMETIMES BRICK-RED OR EVEN A BRIGHT VIOLET. A WHITE OR PINKISH-WHITE FUNGUS COATING IS GENERALLY PRESENT ON AND BETWEEN THE INNER SCALES AND SOMETIMES IT ALSO DEVELOPS EXTERNALLY AT THE BASE OF THE BULBS. THIS COATING CONSISTS OF THE SPORES AND MYCELIUM OF THIS SPECIES OF FUSARIUM THAT CAUSES THE DISEASE.

OCCASIONALLY THE ROT APPEARS TO BEGIN IN THE OLD FLOWER STALK AND PROGRESSES FROM ABOVE DOWNWARD. SEVERELY OR MODERATELY INFECTED BULBS CAN BE RECOGNIZED AND DISCARDED SINCE THEY ARE SOFT, AND EVENTUALLY BECOME HARD, SHRIVELED MUMMIES. LIGHTLY OR NEWLY INFECTED BULBS ARE DIFFICULT TO DETECT SINCE THEY HAVE NOT SOFTENED. HOWEVER, IT IS SOMETIMES POSSIBLE TO DETECT A SOFTENING OF THE BASAL PLATE OF SUCH BULBS, WHICH IS AN EARLY INDICATION OF THE DISEASE.

MICROCONIDIA OF THE FUNGUS ARE MOSTLY UNICELLULAR, SCATTERED OR IN BALLS, AVERAGING 2-3.5 X 5-12 MU. MACROCONIDIA SHOW THE AVERAGE MEASUREMENTS FROM NON-SEPTATE 2-4 X 4-9 MU, TO FIVE-SEPTATE MEASURING 3-4.8 X 36-60 MU.

DISEASES OF BULBS, BY W. C. MOORE. BULLETIN NO. 117 OF THE MINISTRY OF AGRICULTURE AND FISHERIES, P. 74. 1939.

DIE FUSARIEN, BY DR. H. W. WOLLENWEBER & DR. O. A. REINKING. P. 115. 1935.

FUSARIUM OXYSPORUM SCHLECHT. F. NARCISSI SNYDER & HANSEN ON NARCISSUS BULB. THIS DISEASE FREQUENTLY FOLLOWS INJURY CAUSED BY THE NARCISSUS BULB FLY. 77

LARVA OF LAMPETIA EQUESTRIS (F.) 78
(NARCISSUS BULB FLY)

"GUMMING" ON TULIP
BULB.

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UNKNOWN DISEASE ON TULIP BULB
PHILIP SNOWDEN.

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"GUMMING" ON TULIP BULB

THIS GUMMING IS PRESUMABLY A PHYSIOLOGICAL CONDITION SOMETIMES ENCOUNTERED ON BULBS OF TULIPS DERIVED FROM THE SPECIES, TULIPA FOSTERIANA.

UNKNOWN DISEASE ON TULIP BULB - PHILIP SNOWDEN

Urocystis colchici (Schlecht.) Rab., on *Colchicum autumnale* (corms)

This smut produces on the corms and leaves dark blister-like swellings that ultimately burst, exposing the black powdery spore masses of the fungus. It also occurs on the flower stem and perianth.

The disease is described as follows: Sori in leaves, forming slightly elevated areas of varying size and shape, showing through on both sides, at first covered by a lead-colored epidermis, which eventually ruptures, disclosing a granular reddish-black spore mass; spore balls are dark reddish-brown, consisting of 1 - 3 or rarely 4 spores surrounded rather completely by a cortex of tinted, thick-walled ovoid to subspherical sterile cells (7-13 mu), 20-40 mu in length; spores medium-dark reddish brown, irregular oblong to ovoid or subspherical, flattened where in contact, 12-20 mu in length. Sori appearing on the perianth and outer skin and outermost layers of the white corm tissue are similar to those on the leaves.

Reported on several liliaceous hosts in addition to the genus *Colchicum*.

The Ustilaginales of the World, by George Lorenzo Zundel. p. 313. 1945, published in 1953.

UROCYSTIS COLCHICI (SCHLECHT.) RAB. ON BULBOCODIUM BULBS. 81

UROCYSTIS COLCHICI (SCHLECHT.) RAB. ON COLCHICUM AUTUMNALE CORMS. 82

XANTHOMONAS HYACINTHI (WAKK.) DOWSON (YELLOW DISEASE) IN HYACINTHUS BULBS.

83

MYSTROSPORIUM ADUSTUM MASS. (INK DISEASE) ON IRIS RETICULATA BULBS

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Xanthomonas hyacinthi (Wakker) Dowson (*Bacterium hyacinthi* Wakker), in Hyacinthus bulbs

A cross section of a slightly affected bulb will show a number of small isolated yellow spots, often arranged in more or less concentric circles, in the tissues of the closely packed scales. Soon after cutting, and especially on squeezing, a certain amount of a yellow, slimy liquid oozes from these spots. This consists almost exclusively of myriads of bacteria and these are the cause of the disease. If the bulb is cut longitudinally yellow stripes or bands will be seen traversing the scales lengthwise, and sooner or later these stripes reach the basal plate of the bulb. The bacteria in the scales of such a bulb have usually reached it from the foliage and in the early stages they are confined to the vascular bundles (or water-conducting strands) of the leaves and scales. Having reached the basal plate they spread there and pass upwards again into other, still healthy scales.

The organism is yellow, motile, and rod-shaped, with rounded ends and a single polar flagellum. Rods measure 0.4 to 0.6 by 0.8 to 2 microns.

Diseases of Bulbs, by W. C. Moore. pp. 2-3. 1939.

Mystrosporium adustum Mass. (Ink Disease), on *Iris reticulata* bulbs

The most striking symptom of Ink Disease on dry bulbs of *Iris reticulata* is the occurrence on the outer reticulate scales of black, crusty patches or streaks, the appearance of which suggests that the bulbs might have been splashed with ink. The discolored areas may be small and few in number or may cover practically the whole of the membraneous scale, which has a charred appearance. The black crust is an indeterminate mass of dead cells mixed with the mycelium of the pathogen and a variety of other fungal organisms, including at times, but not often, the spores of *Mystrosporium adustum*.

The spores of the above organism are oblong, elliptical or broadly fusiform with obtuse ends, smooth and very dark smoky-brown in color when mature. They usually show 5 - 7 transverse septa, with occasional longitudinal septa, and measure 20-22 X 46-60 mu.

Diseases of Bulbs, by W. C. Moore. p. 134.

Pseudomonas marginata (McCulloch) Stapp. (*Bacterium marginatum* McCulloch), on gladiolus corms

On the corm coat or covering circular, oval or elongated, pale yellow spots develop and these gradually become darker until they are almost black. The husks split, become ragged and look as if they had been charred or burnt.

The corm lesions may occur immediately below those on the husks but more often are found at the base of the corm. They begin as pale yellow, water-soaked, circular spots, the color of which deepens until they are dark brown or almost black. In slight attacks the lesions remain small, as well defined shallow depressions, up to 1/4 inch in diameter, with a very prominent raised "rim" or margin between the healthy and affected tissues. Hence the specific name. They do not extend deeply into the flesh and can often be removed bodily with a penknife, leaving a clean saucer-shaped cavity in the corm. In moderate and severe attacks the spots often coalesce and the decay penetrates deeply into the flesh, causing irregular corroded areas and large cavities. A distinctive feature of the disease is a copious gum-like exudation from the corm lesions. At first the exudate is colorless but it soon becomes honey yellow, later deep brown, and when dry, brittle and shiny. Particles of soil and innumerable bacteria are included in the gum mass. The presence of the gum affords a comparatively reliable method of identifying this disease in the dry corm, for the skin of hard gum over the surface of even the smallest lesion gives it a lacquered or varnished appearance not observed in corm lesions due to other causes.

The rods of the bacterium measure 0.5 to 0.6 by 0.8 to 1.8 microns. Motile with 1 to 4 bipolar flagella.

Diseases of Bulbs, by W. C. Moore. pp. 99-100. 1939.

PSEUDOMONAS MARGINATA (McCUL.) STAPP,
ON GLADIOLUS CORMS

85

PSEUDOMONAS MARGINATA (McCUL.) STAPP, ON
GLADICLUS CORM, SHOWING AN ENLARGED LESION

86

MARMOR MITE HOLMES (TULIP-VIRUS 1), TULIP-BREAKING VIRUS, ON TULIPA SP.

87

MOSAIC - VIRUS ON NARCISSUS LEAF

88

Marmor mite Holmes (Tulip-virus 1), Tulip-Breaking Virus

Symptoms: "breaking" of the flower color in the form of striping, flaming, or feathering. Investigators have shown this loss of flower color is caused by infection with a color-removing virus at times designated as Tulip-virus 1. This disease may also cause a mottling of the foliage. Such mottled areas contain small chloroplasts poor in chlorophyll.

Still another virus of tulips, Marmor tulipae Holmes (Tulip-virus 2), causes a color change in tulip blooms by intensifying the color in stripes. At other times both viruses may be found in the same plant, which results in both color loss and intensification in different parts of the same flower.

Marmor mite is naturally transmitted by aphids and can be mechanically transmitted by bulb grafting.

W. H. Wheeler

Narcissus-Mosaic Virus

Narcissus mosaic affects all parts of the plant but produces symptoms sufficiently distinctive for identification purposes only on the leaves and flowers.

The virus prevents the formation of the green coloring (chlorophyll) in portions of the leaves as they develop; therefore, the expanded leaves exhibit various mottles or stripes (as illustrated), produced by the resulting variations in the distribution of the chlorophyll. The unaffected, deeply pigmented areas remaining suggest irregularly shaped, blue-green islands surrounded by lighter colored, faded areas.

The effect on flowers is even more conspicuous than the leaf symptoms. Flowers are reduced in size, are of poor texture, with shorter stems and develop very prominent hyaline streaks or translucent, cleared areas in the trumpets or cups and perianth segments. This translucent streaking or clearing of flower parts is one of the most distinctive symptoms of narcissus mosaic.

Transmission: By bulb grafting and aphids, but not through the soil or seed.

Diseases of Narcissus, by Frank P. McWhorter and Freeman Weiss. Bull. Oregon Agricultural Experiment Station No. 304, pp. 18-19. 1932.

DITYLENCHUS SP. IN CORM OF
COLCHICUM SP.

89

DITYLENCHUS SP. INJURY
IN SCILLA BULBS

90

DITYLENCHUS SP., IN SPANISH IRIS BULBS.

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DITYLENCHUS SP., INJURY ON DUTCH IRIS BULBS

92

Nematodes or Eelworms
Ditylenchus dipsaci (Kuhn) Filip. and Ditylenchus sp.

The six photographs illustrate nematode symptoms on bulbous iris, narcissus, colchicum and scilla. The difference between infection of iris and narcissus bulbs is very definite as is shown in the pictures. Symptoms on narcissus are difficult to find unless the bulb is cut.

Nematodes can be classified into two general groups, those that attack leaves and stems and those attacking underground parts.

Ditylenchus dipsaci, the stem and bulb eelworm, is the most important economically.

In colchicum the infection begins at the root plate, which is destroyed. The disease begins with yellowish or brown streaks, which gradually spread out on the surface and penetrate deeply into the corm. The destroyed tissue is soon completely decayed and forms a black powdery mass.

The affected surface scales of scilla bulbs are shriveled and exhibit a brown to black discoloration, whereas the inner scales show characteristic brown ring symptoms.

To find nematode infections on iris bulbs the brown outer skin should be removed. When well advanced the symptoms on Dutch and Spanish iris are very distinct, as illustrated in the photographs. Earlier symptoms are often indistinct and difficult to detect, since infection progresses while the bulbs are in storage.

In narcissus and hyacinth bulbs the infection usually enters at the neck of the bulb. Some of the eelworms will be carried upward in the rapidly growing leaves and stems, where they may be detected by the distortion and discoloration they cause. Swellings and light spots show where the eelworms are breeding. As the foliage dries they become inactive, but will resume activity if the leaves become moist. Those working down into the bulb increase and work their way around the scale they enter, eventually destroying the bulb. After the bulb decays the nematodes enter the soil in search of fresh bulbs or other hosts.

The present nomenclature of the so-called Ditylenchus dipsaci is in a state of considerable confusion. Some workers are inclined to consider the nematodes attacking the various bulbs and corms as separate, although closely related species. Hence any specific names now used may later be subject to change.

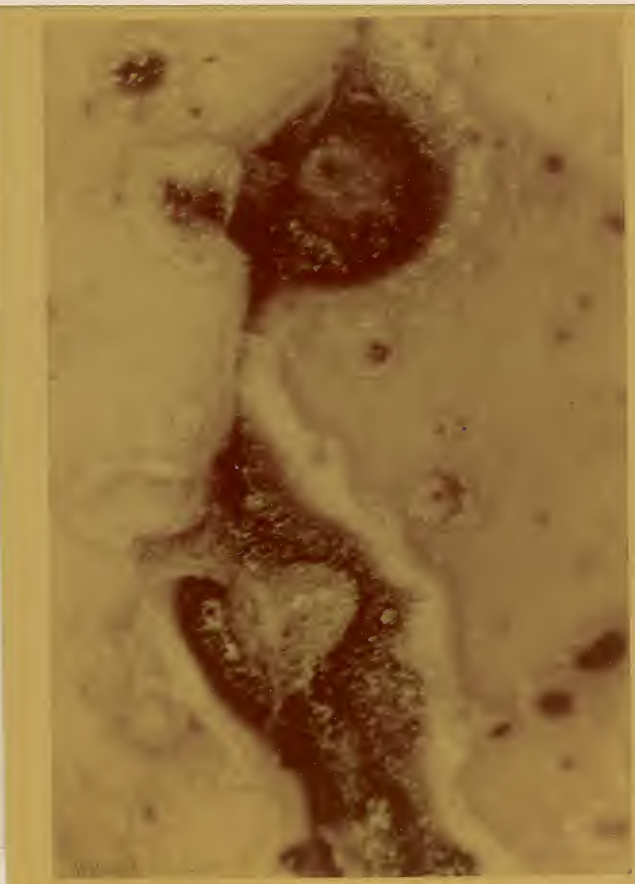
A Manual of Agricultural Helminthology, by I. N. Filipjev & J. H. Schuurmans Stekhoven, Jr. pp. 313-317. 1941.

The Daffodil, by M. J. Jefferson-Brown. 1951.

DITYLENCHUS SP. - CROSS SECTION OF ROOT BASE OF INFECTED AND NON-INFECTED IRIS BULBS 93

DITYLENCHUS DIPSACI (KUHN) FILIP., SHOWING CROSS SECTION OF INFECTED NARCISSUS BULB 94

STROMATINIA GLADIOLI (DRAYT.) WHET., 95
ON GLADIOLUS CORMS



STROMATINIA GLADIOLI (DRAYT.) WHET., 96
SHOWING AN ENLARGED LESION ON GLADIOLUS CORM.

Stromatinia gladioli (Drayton) Whetzel, formerly called Sclerotinia gladioli (Massey) Drayt., on Gladiolus

The sclerotia of S. gladioli are black and consist of a well-defined compact rind of thick-walled cells surrounding a thin-walled pseudoparenchymatous medulla, the cells of which are filled with oil globules. They vary considerably in size and tend to be larger in culture than on the host, but they all fall within a diameter range of 90-300 mu. Globose microconidia 1.2 - 1.8 mu in diameter, which function as spermatia, are formed in abundance in culture, and on nutrient media rich in carbohydrates, black stromatic tissues, 80-500 mu thick, develop, on which columnar, branched or unbranched receptive bodies 0.8-1.9 mm. tall and 0.4-0.8 mm. broad are produced. On being fertilized by microconidia from another strain of the fungus these receptive bodies may develop into brown, densely caespitose, stipitate apothecia, 3 - 7 mm. broad and 6 - 10 mm. high. Asci cylindrical to cylindroclavate, opening by a pore, 8.5-9.2 X 190.5-235.4 mu, average 9.06 X 212.5 mu. Ascospores 8, unicellular, uniseriate, ellipsoidal, hyaline, uninucleate, 5.6-9.5 X 10.2-16.75 mu, average 7.25 X 14.04 mu. Paraphyses abundant, filiform to slightly clavate at apex, septate, hyaline 2.8 - 3.2 mu in diameter.

Diseases of Bulbs, by W. C. Moore. p. 111. 1939.
Gladiolus Dry Rot, by F. L. Drayton, Phytopathology V.24:402-404. 1934.

Botrytis gladiolorum Timmermans, on gladiolus corm

Mycelium on gladiolus corms is white, woolly, often profuse.

Sclerotia (illustrated) on corms developed abundantly, first as smooth creamy white bodies soon becoming black, later coalescing into large coralloid masses.

Conidia freely produced on flowers in the field and to a less extent on corms. Conidiophores paler towards the top, average diameter up to 18 mu, cells variable in length; conidia borne on ampulles on main stalk or side branches, terminal or lateral, uniform in size, averaging 8 X 13 mu, generally 1-celled, ovoid, formed in the presence of light, germinating generally by one or sometimes two germ tubes. Abnormal spores are occasionally produced and are sometimes bicellular, but their most striking feature is their variable length, which may reach 50 mu.

Transaction British Mycological Society V.32, Parts III & IV, p. 302. 1949.

Sclerotium cepivorum Berk., on Allium sativum (garlic bulb)

This disease, commonly known as white rot, affects onions, leek, garlic and shallots. It may attack the plant at any time during the growing period; moreover, it is not uncommon for it to continue as a bulb rot following harvest. The fungus attacks both roots and bases of scales and is itself usually conspicuous by an abundance of superficial, white, fluffy mycelium. The roots are gradually destroyed and the fungus causes a semi-watery decay of the scales. Rather early in the development, minute, black sclerotia are formed. These are uniformly spherical, hard, and not over a half millimeter in diameter. They form either on the surface of or are imbedded within the decaying tissue and are readily detached as the decay progresses. In extreme cases the entire subterranean portion of the plant may be almost completely destroyed.

White rot has perhaps been most commonly confused with the Botrytis rots which affect onion bulbs following harvest. While the type of decay is somewhat similar, there are several easily distinguishable points of difference. The sclerotia of white rot, which are so abundant and constant except in the very early stages, are less than one millimeter in diameter and thus much smaller than those of the three forms of Botrytis. The latter most commonly invade through the neck of the bulb, while white rot invariably enters at the base.

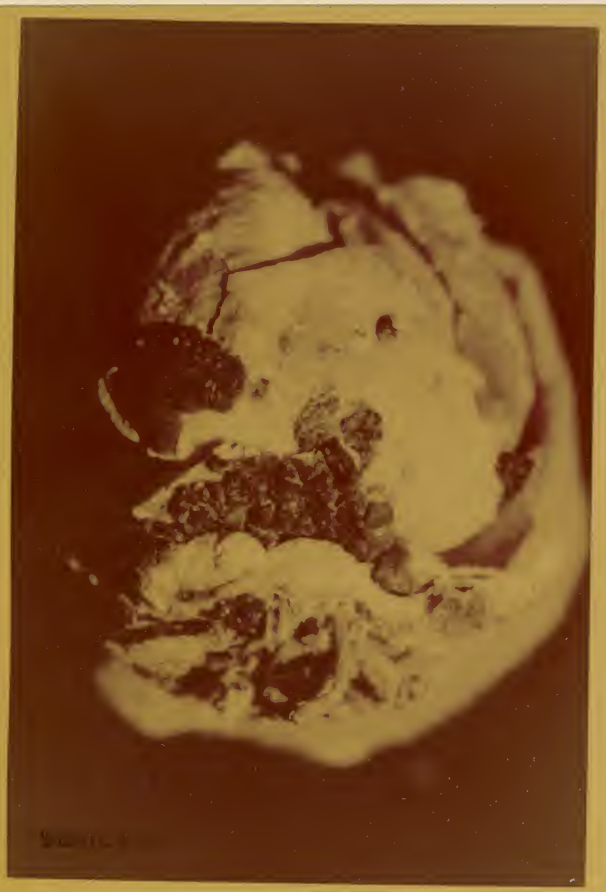
Phytopathology 14:315-322. 1924.

BOTRYTIS GLADIOLORUM TIMM., ON GLADIOLUS CORM

97

SCLEROTIUM CEPIVORUM BERK., ON ALLIUM SATIVUM (GARLIC BULB)

98



BOTRYTIS ELLIPTICA (BERK.) CKE., ON LILIUM SP. 99

RHIZOCTONIA TULIPARUM WHET. & J. M. ARTH., ON TULIPA SP. 100

Botrytis elliptica (Berk.) Cooke, on Lily Bulb

The conidiophores of B. elliptica are numerous, 1 - 3 mm. long, branched, with pale brown walls, and they bear at their tips clusters of elliptical, hyaline, later sometimes pale brown conidia averaging 16 X 24 mu, with a range of 14-16.5 X 20-25 mu (10-24 X 16-34 mu according to Westerdijk and van Beyma). In Holland and England two strains of the fungus have been described, one of which produces sclerotia while the other does not. Van Beyma and van Hell made a comparative study of these two strains and found that the one not forming sclerotia was a weak parasite and caused no real damage.

Diseases of Bulbs, by W. C. Moore. p. 42. 1939.

Rhizoctonia tuliparum Whet. & J. M. Arth. [Sclerotium tuliparum (Klebh.) not Schlecht.], on Tulipa sp.

This pathogen depends upon its sclerotia to tide it over from one season to the next. Mycelium, which is readily produced from the sclerotia, spreads through the soil and attacks the bulb.

On digging up the diseased bulbs, one is at once struck by the fact that the soil clings tenaciously to the exterior of the rotted parts. This is evidently due to the external mycelium, which binds the soil particles together and holds them to the rotted bulb scales. Embedded in the soil about the bulb are numerous, more or less globose, dark brown bodies, the sclerotia of the pathogen. These when dry become almost black. They vary from 1 to 9 mm. in diameter and are dull, fibrillose and irregular, as contrasted with the smooth, polished surface of Botrytis and Sclerotinia. They are often present also in large numbers on the surface of the rotted scales and neck of the bulb under the adhering soil. Some are occasionally to be found within the rotted bulb between the decayed scales.

A cross section through a sclerotium shows the interior to be light yellowish brown in color, but of a much lighter tint than the outer narrow zone forming the rind. This colored medulla is in striking contrast to the white medulla of the sclerotia of Sclerotinia bulborum or S. sclerotiorum, to which these sclerotia bear a superficial resemblance. There is an abundance of grayish white mycelium on the outer surface of the bulb covering the diseased parts. Within the bulb this mycelium frequently forms a felty layer between the diseased scales.

The Gray Bulb-Rot of Tulips Caused by Rhizoctonia tuliparum (Klebh.) N. comb., by H. H. Whetzel & John M. Arthur. Cornell University Agricultural Experiment Station Memoir 89 - March 1925.

Botrytis tulipae (Lib.) Lind., on Tulipa sp.

This organism occurs wherever tulips are grown, and in some seasons it causes severe damage. It is easily overlooked on slightly affected bulbs.

Spots on the leaves are minute, circular or somewhat elongated, slightly sunken, yellowish, each surrounded by a dark green, water-soaked area. The lesions on the flower stalks resemble those on the leaves, but are more elongated and depressed, and appear as dark brown patches on which sclerotia frequently develop. The seed pods of tulips are very susceptible and the mycelium of the fungus has been found in the seed.

The external brown outer skin of the bulb, and especially the old, dried flower stalk, commonly bear the resting bodies or sclerotia of the fungus, partially embedded in the plant tissues. These sclerotia, which rarely exceed the size of turnip seed, are white when young, and shiny black when mature. If the brown scale is removed circular lesions, having a somewhat raised margin and depressed center, may frequently be seen on the outermost fleshy scale. They are of a deep yellow or brown color and may or may not bear sclerotia on the sunken portions.

The conidiophores of B. tulipae emerge through the stomata singly or in pairs. They are olivaceous-brown above, hyaline below; the basal cell of each is somewhat swollen and the upper part is furnished with 3 - 5 short lateral branches. After producing one head of conidia the main axis of the conidiophore may continue growth and produce a second, third or fourth head, so that a mature conidiophore often appears to bear whorls of conidia. The conidia are hyaline or clear gray, variable in size, from 10-13 X 16-20 mu to 8-20 X 12-24 mu and each is borne on a short sterigma.

Diseases of Bulbs, by W. C. Moore. pp. 20-25. 1939.

Sclerotinia narcissicola Gregory, on Narcissus Bulb

(Botrytis narcissicola Kleb. is the conidial stage)

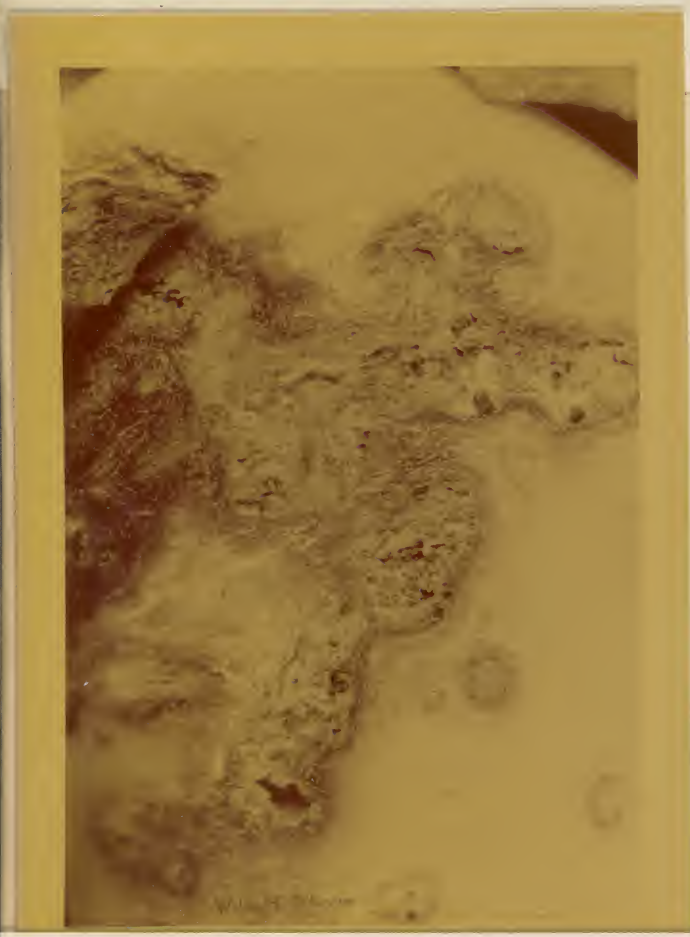
On examining the bulbs after lifting, the sclerotia of B. narcissicola may be found just below the outer papery scales as small, black granular, flattened bodies about the size of mustard seed or up to half an inch long, if several are joined together. During the summer the fungus generally remains inactive, but if storage is prolonged into the autumn it begins to attack the basal plate and the scales, producing yellowish-brown rotted tissue in which sclerotia can usually be found embedded.

Conidiophores are 1 mm. or more long, unbranched or slightly branched above, brownish gray below and paler above; conidia are oval, somewhat pointed at the lower end, pale brown in color and measure 6-7 X 10-12 mu.

Diseases of Bulbs, by W. C. Moore. pp. 67-68.

BOTRYTIS TULIPAE (LIB.) LIND.,
ON TULIPA SP.

101



SCLEROTINIA NARCISSICOLA GREGORY,
ON NARCISSUS BULB. (CONIDIAL OR IMPERFECT
STAGE IS BOTRYTIS NARCISSICOLA KLEB.)

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PENICILLIUM GLADIOLI McCUL. & THOM., CLOSE UP OF SCLEROTIA ON GLADIOLUS SP. CORM

103

PENICILLIUM GLADIOLI McCUL. & THOM., ON GLADIOLUS SP.

104

PENICILLIUM GLADIOLI McCUL. & THOM., ON GLADIOLUS SP.

THE CONIDIOPHORES OF P. GLADIOLI DEVELOP IN TUFTS ON FASCICLES UP TO 2 MM. LONG. THE PENICILLUS CONSISTS OF THE MAIN AXIS OF THE CONIDIOPHORE WITH OR WITHOUT ONE OR TWO BRANCHES, BEARING FEW METULAE 10 - 12 MU LONG, AND VERTICELS OF FEW STERIGMATA 1.5-2 X 12-14 MU; ELLIPTICAL-FUSIFORM, SMOOTH SPORES, MEASURING 2.5-3 X 2.8-3.6 MU, ARE BORNE IN LONG CHAINS. WITH AGE THE FUNGUS PRODUCES SMOOTH SCLEROTIA 140-540 MU IN DIAMETER, AT FIRST CREAM TO LIGHT PINKISH TAN IN COLOR, LATER PALE BROWN OR TAN. THIS IS A DISTINCTIVE BEHAVIOR OF THIS SPECIES.

DISEASES OF BULBS, BY W. C. MOORE. P. 119. 1939.

THIS CONDITION, TERMED SCALD, WAS CHARACTERIZED BY THE PARALLEL MARKINGS ON THE INJURED PORTIONS OF THE BULB SCALE.

PENICILLIUM GLADICLI McCUL. & THOM., LESIONS ON GLADIOLUS CORM FOLLOWING MECHANICAL INJURY 105

SCALD CAUSED BY STORAGE CONDITIONS FOLLOWED BY BACTERIAL ROT, ON TULIPA SP. BULB 106

FUSARIUM OXYSPORUM SCHLECHT. F. GLADIOLI (MASSEY) 107
SNYDER & HANSEN, SHOWING CENTRAL CORE ROT IN
GLADICLUS CORMS.

FUSARIUM OXYSPORUM SCHLECHT. F. GLADIOLI (MASSEY) 108
SNYDER & HANSEN, SHOWING CROSS SECTION OF INFECTED
GLADIOLUS CORMS

Fusarium oxysporum Schlecht. f. *gladioli* (Massey) Snyder & Hansen

At the time of harvesting the corms in the autumn, Fusarium rot lesions appear as small water-soaked spots. They are of a reddish-brown color and occur in most cases on the sides and lower halves of the corms. It is usually necessary to remove the husks (sheathing leaf bases) from the corms in order to see the lesions, although in some cases the husk is also diseased, as indicated by its discoloration and unusual brittleness.

The rot advances during storage, the rate increasing with higher temperatures and increased humidities. Lesions are usually irregularly circular in outline and range in size from one-fourth to one inch in diameter depending upon conditions of storage and time of year. The entire corm may become involved and reduced to a dry, brownish-black, worthless mummy due to the coalescence of two or more lesions.

Perhaps the most characteristic symptom of this disease is the existence of prominent, irregularly concentric markings or ridges in the lesions. Unfortunately, the absence of these markings is not absolute proof that the disease is not Fusarium rot; however, they occur more often than not, and the writer has never observed them in lesions produced in any other gladiolus disease.

The lesions are generally somewhat sunken due to the rapid drying and shrinking of the tissues. The advancing margins are usually definite and slightly raised, with active lesions showing a narrow, water-soaked outer area, dark in color, which blends sharply into the healthy tissue. Diseased tissue is hard and in most cases not over 5 to 7 mm. in thickness.

Fusarium rot is primarily a disease of stored corms, but certain conditions of disease in the field relate directly to the rot which advances during storage. Missing plants in the row may be due to the fact that the corms planted were worthless mummies, their rotted condition being concealed by the apparently healthy husks. Dwarfed, stunted plants, which frequently fail to produce blossoms, result from planting corms so severely diseased that they fail to develop root systems or conducting tissues sufficient to support the developing offspring. Diseased corms commonly decay prematurely in the field, saprophytes, in many if not most cases, playing an important role in the rapid disintegration of the tissues.

When corms affected with the Fusarium rot are kept under very moist conditions, the lesions commonly become covered with a grayish, mold-like growth of the fungus.

Microconidia of the fungus are numerous and nearly always non-septate. Wollenweber and Reinking in their 1936 book, "Die Fusarien", show the average measurements for the non-septate macroconidia to be 2.7 X 6 mu; at the other extreme are 7-septate macroconidia with average measurements of 4.8 X 42 mu.

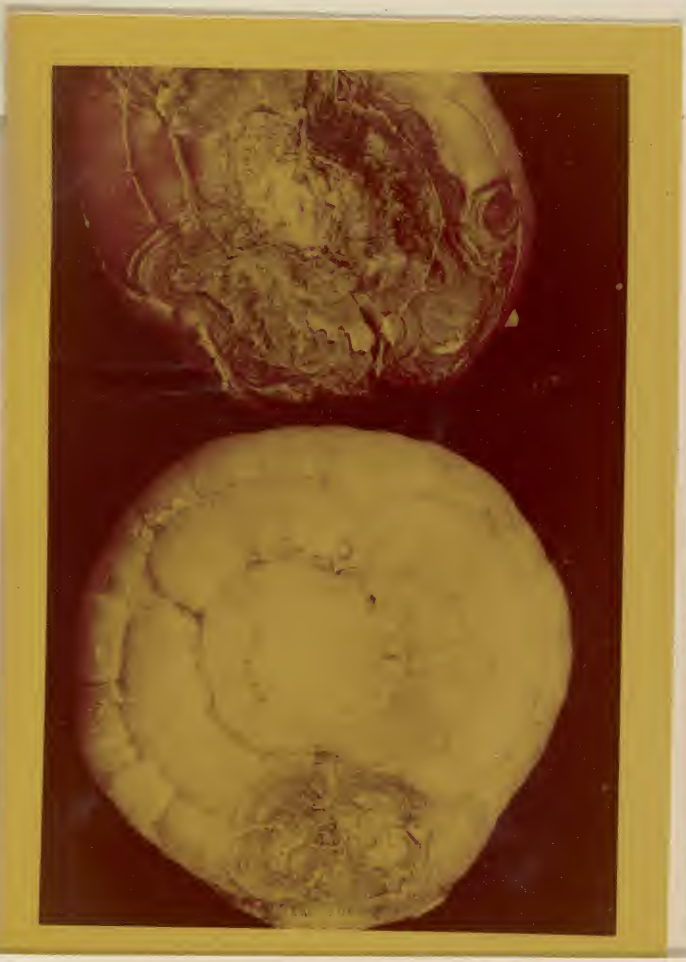
From an article by L. M. Massey, Phytopathology V.16:510. 1926.

The light colored growths evident on the Crocus corms are growths which followed an attack by Fusarium. They are composed of mycelium and spores of the Fusarium, as well as spores and mycelium of several saprophytic organisms.

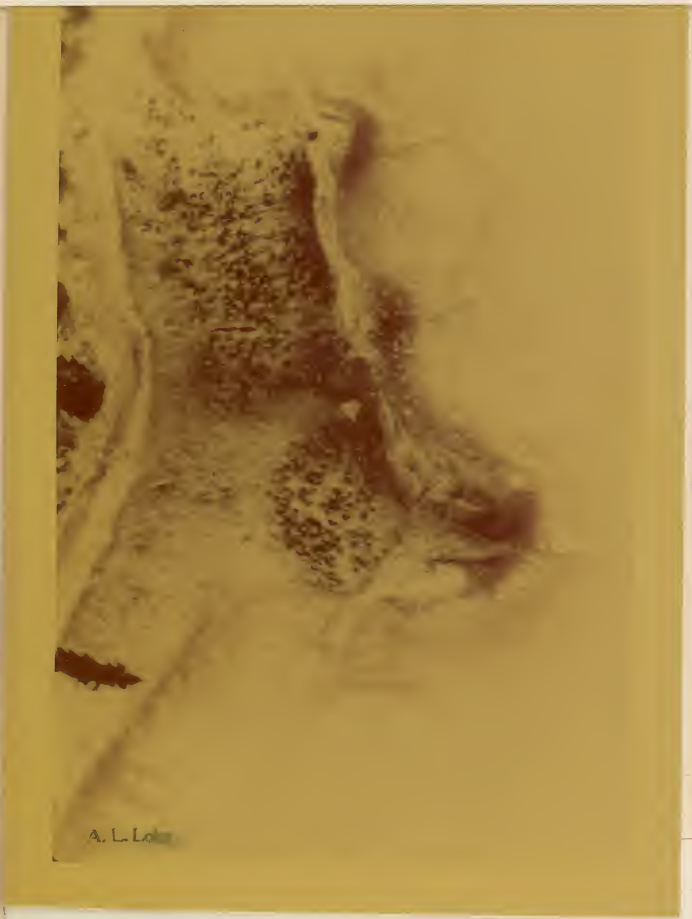
Fusarium sp., probably *F. oxysporum* Schlecht., on Crocus corms

See last paragraph on sheet for *F. oxysporum* Schlecht. *f. gladioli* (Massey) Snyder & Hansen.

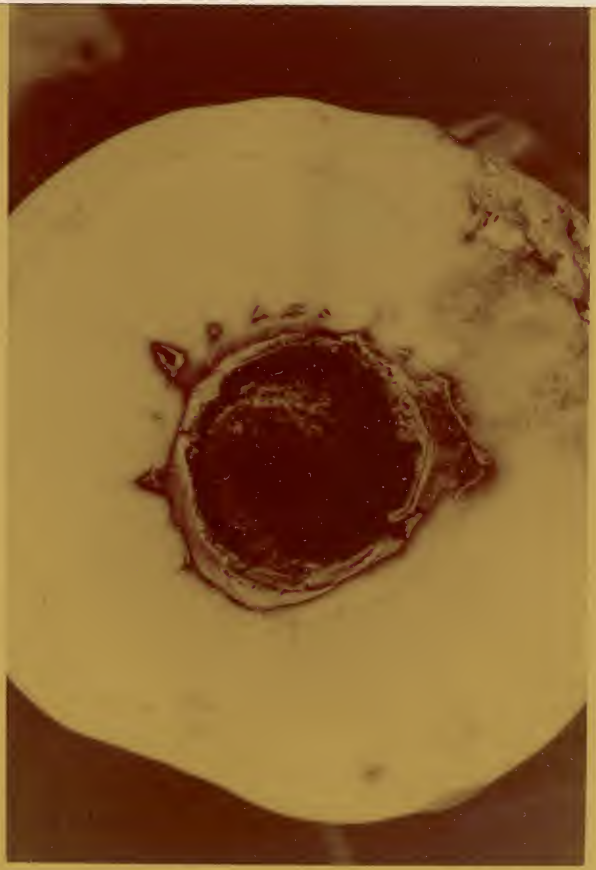
FUSARIUM OXYSPORUM SCHLECHT. F. GLADIOLI (MASSEY) SNYDER & HANSEN ON GLADIOLUS CORMS 109



FUSARIUM SP. PROBABLY F. OXYSPORUM SCHLECHT. ON CROCUS CORMS. 110



MACROPHOMINA PHASEOLINA (TASSI) GOID., SHOWING AN ENLARGED LESION ON GLADIOLUS CORM 111



MACROPHOMINA PHASEOLINA (TASSI) GOID., ON GLADIOLUS. SYNONYMS: MACROPHOMA PHASEOLI MAUBL., SCLEROTIUM BATATICOLA TAUB., RHIZOCTONIA BATATICOLA (TAUB.) BUTL., MACROPHOMINA PHASEOLI (MAUBL.) ASHBY 112

MACROPHOMINA PHASEOLINA (TASSI) GOID., ON GLADIOLUS SP. AND IPOMOEA BATATAS

PYCNIDIA SPARSE TO GREGARIOUS, SOMETIMES HOWEVER 2 - 3 JOINED TOGETHER COMPACTLY, GLOBOSE TO DEPRESSED-GLOBOSE, 100 - 200 MU IN DIAMETER, IMMERSED TO ERUMPENT, OR SOMETIMES IMMERSED IN A COMPACT COTTONY MYCELIUM, SLIGHTLY EFFUSE AND SCARCELY EVIDENT, COMPOSED OF A PARENCHYMATIC WALL MADE UP OF 3 - 4 LAYERS OF CELLS, ANGULAR, STRONGLY MEMBRANACEOUS, BROWNISH-BLACK, RECTANGULAR, LARGE DIAMETER APPROXIMATELY 9 MU, AND ALSO OF HYALINE CELLS, ROUND, PROTOPLASMIC, CONTENTS GRANULOSE-GUTTULATE, 4 - 8 MU IN DIAMETER DEVELOPING INTO CYLINDRICAL-PHIALIFORM, STRAIGHT TO CURVED CONIDIOPHORES, APEX SLENDER, 9 - 15 MU LONG; CONIDIA ACROGENEOUS, HYALINE, EPISPORE THICK, CONTINUOUS, PROTOPLASM GRANULAR TO MINUTELY GUTTULATE, IRREGULARLY LONG CYLINDRICAL, NEVER CURVED, 6-11 X 16-30 MU, AVERAGING 7-8 X 20-25 MU.

MYCELIAL HYPHAE COMPOSED OF FILIFORM TO SOMEWHAT THICKENED BROAD CELLS UP TO 5 - 7 MU, REGULAR CALIBER, SEPTATE, FREQUENTLY BRANCHED, SECONDARY BRANCHES FORMED AT RIGHT ANGLES ALSO ANASTOMOSED, AT FIRST HYALINE THEN DARK REDDISH-BLACK, PENETRATING DEEPLY INTO THE MATRIX AND THEN FORMING MICROSCLEROTIA (CALLED SCLEROTIUM BATATICOLA (TAUB.) BUTLER) IMMERSED TO ERUMPENT, SPARSE TO GREGARIOUS, TYPICALLY SPHERICAL 50 - 100 MU IN DIAMETER COMPOSED OF ANGULAR CELLS ARRANGED IN THE FORM OF A FALSE PARENCHYMA, FULL OF COPIOUS REFRACTIVE OIL DROPS.

FOUND IN ROOTS, LEAVES, STEMS, AND TUBERS OF HERBACEOUS TO WOODY PLANTS OF MANY GENERA, CAUSING GREAT DAMAGE, PRODUCING DISEASES CALLED "ASHY ROT", "CHARCOAL ROT", "COLLAR ROT", "MARCIUME RADICALE", "WURZELFÄULE".

PYCNIDIA AND MICROSCLEROTIA ARE USUALLY FOUND IN LIVING HERBACEOUS OR WOODY PLANTS IN WHITISH-GRAY SPOTS, PYCNIDIA ARE RARELY FOUND IN ARTIFICIAL CULTURE MEDIA.

GOIDANICH, G. REVISIONE DEL GENERE MACROPHOMINA PETRAK SPECIE TIPICA: MACROPHOMINA (TASSI) GOID. N. COMB. NEC. M. PHASEOLI (MAUBL.) ASHBY BOL. STAZ. DI PATOLOGIA VEGETALE ROME ANNO V, (SER. TERZO) 1949 - 1950. PP. 63-65.

Aspergillus flavus Link. and *Aspergillus niger* mut. *cinnamomeus* Thom. & Raper, on *Tulipa* sp.

The genus *Aspergillus* is composed of a considerable number of group species of almost universal distribution in temperate and tropical climates. Few, if any, can be considered true parasites. However, they are of frequent importance as rot fungi when mechanical injury to the host affords an avenue of entrance. The photograph ably illustrates their role as rot fungi.

The dark spored members of the genus can easily be confused with another rot organism, *Rhizopus nigricans*, unless the structure and spore measurements of each is carefully checked. Conidia of the Aspergilli are borne on bodies termed sterigmata, set on an inflated head called a vescicle, which is the expanded end of the stalked conidiophore. These spore masses are naked. The spores themselves will seldom exceed 5 mu in diameter.

Spores of *R. nigricans*, averaging 11 - 14 mu in diameter, are thus distinctly larger than the Aspergilli. Superficially, the spore-bearing sporangium resembles the spore masses of Aspergillus, but it is covered with a thin membrane which easily bursts to expose the dark spores and the columnella, a small column-like projection in the center of the sporangium.

Forms of *A. niger* are important commercially since a large amount of the citric acid used today is produced by the culture growth of that fungus.

W. H. Wheeler

ASPERGILLUS FLAVUS LINK., & ASPERGILLUS NIGER MUT. CINNAMOMEUS THOM. & RAPER, ON TULIPA SP. 113

MACROPHOMINA PHASEOLINA (TASSI) GOID. SHOWING AN ADVANCED STAGE OF INFECTION IN A GLADICLUS CORM. 114

RHIZOCTONIA SP. (SCLEROTIA) ON TULIP BULB. 115

SCLEROTIUM SP., ON LYCORIS SP. 116

THE PHOTOGRAPH SHOWS THE SCLEROTIA OF AN APPARENTLY UNDESCRIBED SPECIES OF *RHIZOCTONIA* ON A TULIP BULB.

THE SCLEROTIA ILLUSTRATED ON THE LYCORIS BULB REPRESENT AN APPARENTLY UNDESCRIBED SPECIES OF *SCLEROTIUM*.

Concentric Rings on Gladiolus Corms

Certain varieties of gladiolus exhibit these superficial corm markings. The variety shown is "Jeanie", and wherever it grows the same marks are found. The flower stems produced by this gladiolus usually show a creamy colored mottling. All this suggests a virus infection, although that has apparently not yet been proven.

W. H. Wheeler

Brown Concentric Markings on Gladiolus Corms

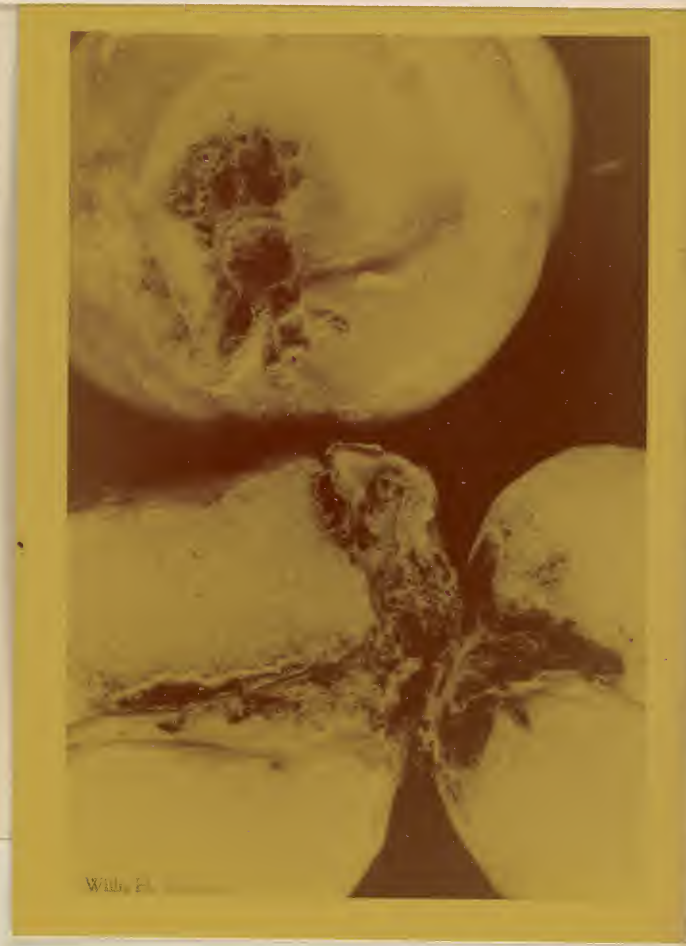
Several corms in a domestic lot of gladiolus showed this condition, which was only "skin deep". Cause was not determined. While the markings superficially resembled gladiolus thrips injury, it was not caused by thrips. This might have been a manisfestation of a virus infection.

W. H. Wheeler

CONCENTRIC RINGS (CAUSE UNKNOWN) ON GLADIOLUS CORMS. 117

BROWN CONCENTRIC MARKINGS OF UNKNOWN ORIGIN ON GLADIOLUS CORMS. 118

UROCYSTIS GLADIOLICOLA AINSWORTH 119
(U. GLADIOLI (REQ.) SM.) ON GLADIOLUS CORMS



UROCYSTIS GLADIOLICOLA AINSWORTH ON GLADIOLUS 120
SHOWING INSIDE OF CUT CORM AND BASE OF ONE
UNCUT.

UROCYSTIS GLADIOLICOLA AINS., ON GLADIOLUS CORMS

SORI IN THE LEAVES, AS DARK BROWN BLISTERS PARALLEL WITH THE VEINS, 1 MM. TO SEVERAL CENTIMETERS IN LENGTH, EXTENDING DOWN TO THE CORMS, AT FIRST COVERED BY THE EPIDERMIS, WHICH SOON RUPTURES TO EXPOSE THE DARK BROWN TO BLACK POWDERY SPORE MASS; SOMETIMES IN THE HARVESTED CORMS AS INTERNAL DECAY.

SPORE BALLS GLOBOSE, 17-28 MU IN DIAMETER, EACH COMPOSED OF ONE OR OCCASIONALLY TWO SPORES COMPLETELY INVESTED BY THE CORTEX OF SMALLER, YELLOWISH, STERILE CELLS.

SPORES GLOBOSE OR SLIGHTLY ANGLED, REDDISH BROWN, 11-16 MU IN DIAMETER, SMOOTH.

INSPECTION FOR THIS DISEASE IS DIFFICULT BECAUSE ITS SYMPTOMS ARE NOT ALWAYS PROMINENT ON THE CORM, BUT ARE BURIED IN THE FLESH.

MANUAL OF NORTH AMERICAN SMUT FUNGI, BY GEORGE W. FISCHER. P. 219. 1953.

Multi-Vision
PAT. PEND.

HORN

No. 7882 C

GENUINE LEATHER